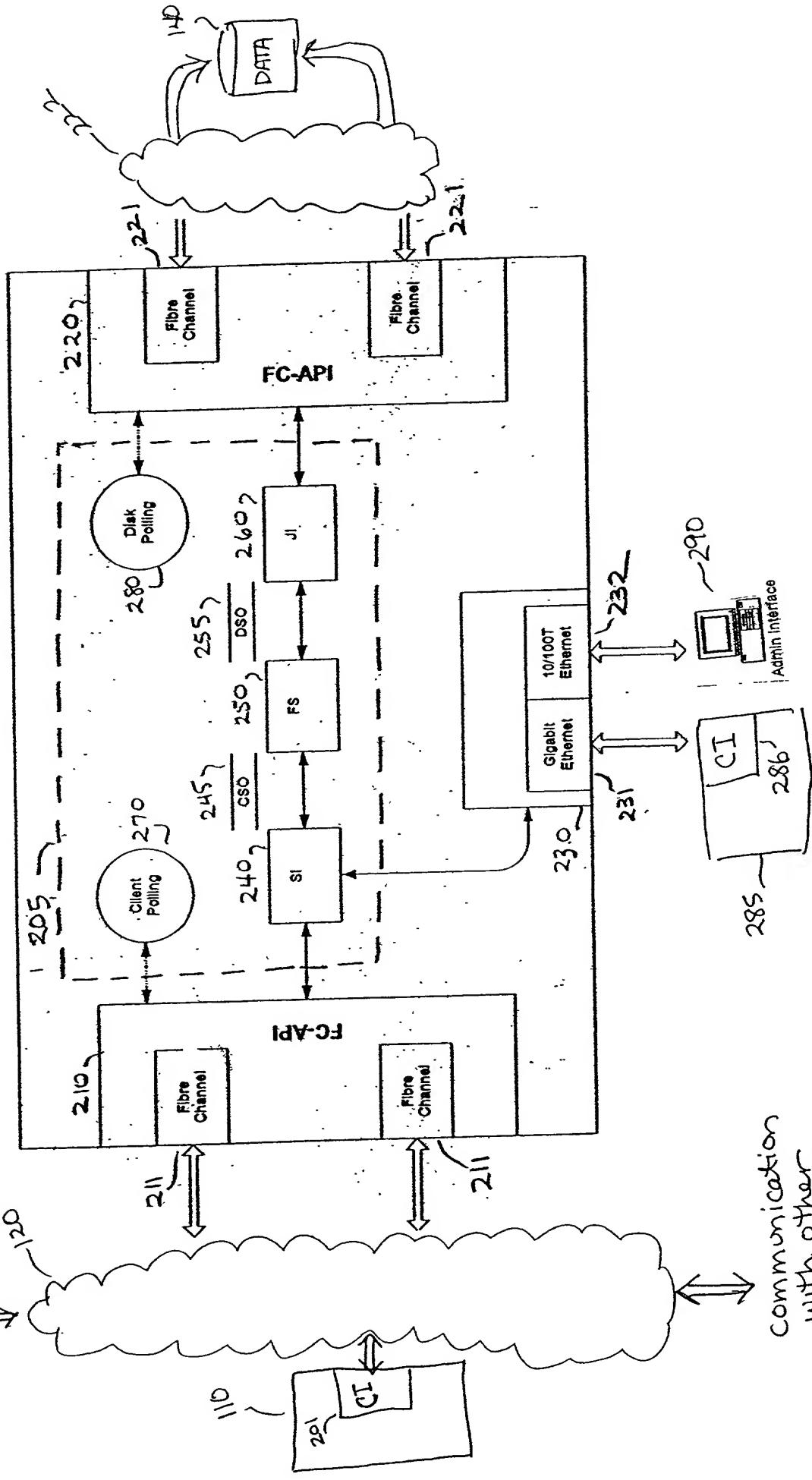


FIGURE 1 - General Overview of Distributed File Storage System

Communication  
with other server  
nodes



Communication  
with other  
Server nodes

FIGURE 2 : One Embodiment of a Server Node

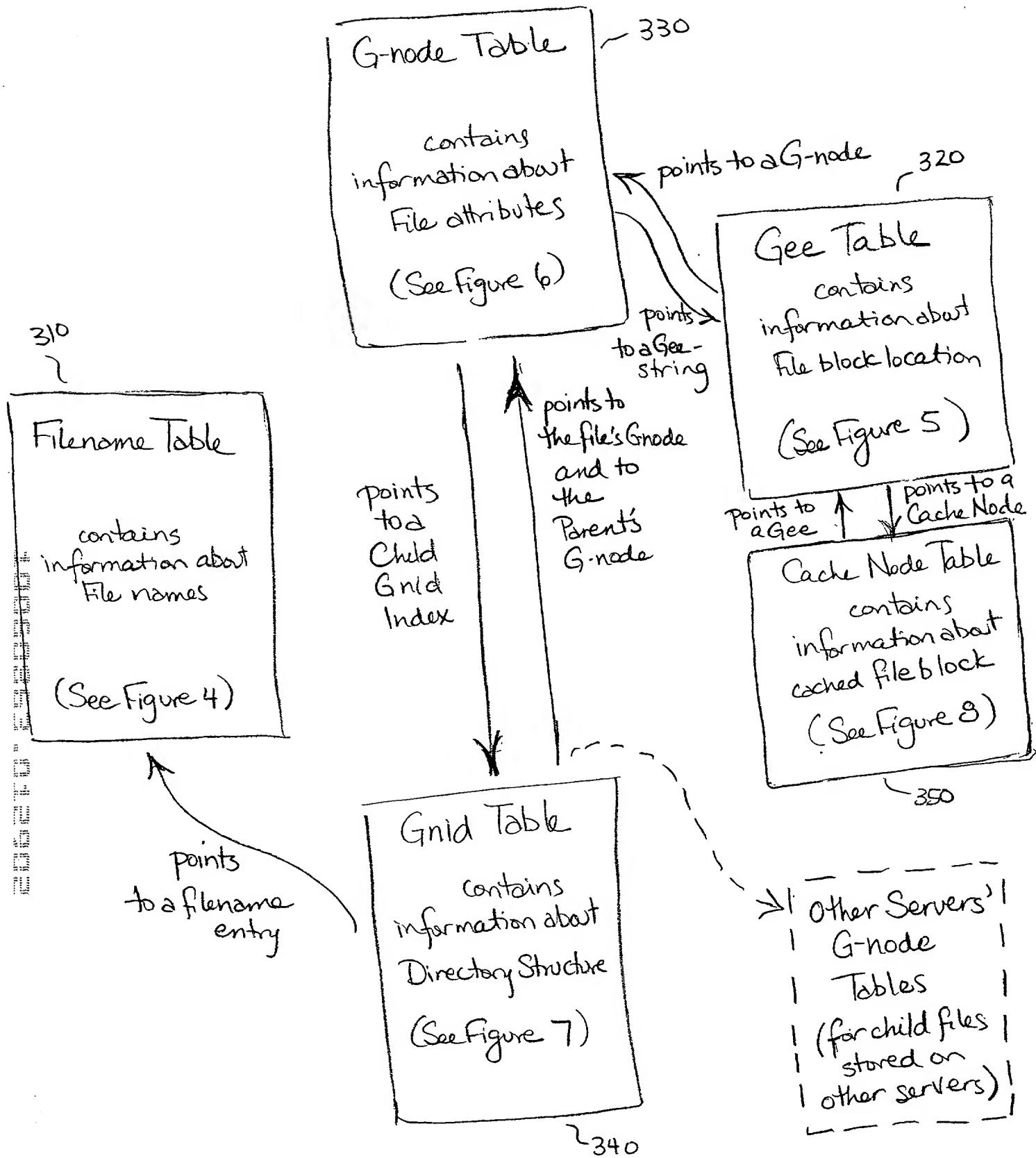


FIGURE 3 - Five metadata structures

310

Array Index	
411	70
412	71
413	72
414	73
421	74
422	75
423	76
424	77
411	78
420	79
424	80
421	81
422	82
423	83
424	84
	<SOS>
	csum
	3
	'D'
	'o'
	'e'
	<SOS>
	csum
	6
	'T'
	'h'
	'o'
	'm'
	'a'
	'S'

Array Index	
85	-431
86	-432
87	-433
88	-434
89	-441
90	-442
91	-443
92	-444
93	430
94	440
95	
96	
97	
	<DS>
	csum
	4
	'F'
	'r'
	'o'
	'g'
	<SOS>
	csum
	2
	'T'
	'T'
	<SOS>

FIGURE 4 - Sample Portion of a Filename Table

320

590

591

592

Index	G-Code	Data	File Logical Block
S10-	45	GNODE	Gnode = 67, Extent = 2, Root = TRUE
S11-	46	DATA	Disk Logical Blocks: 456, 457 Drive 13
S12-	47	DATA	Disk Logical Blocks: 667, 668 Drive 15
S13-	48	DATA	Disk Logical Blocks: 112, 113 Drive 19
S14-	49	PARITY	Disk Logical Blocks: 554, 555 Drive 2
S15-	50	DATA	Disk Logical Blocks: 458, 459 Drive 13
S16-	51	DATA	Disk Logical Blocks: 669, 670 Drive 15
S17-	52	DATA	Disk Logical Blocks: 119, 120 Drive 19
S18-	53	PARITY	Disk Logical Blocks: 556, 557 Drive 2
S19-	54	LINK	Index 76
	...	...	
S20-	76	GNODE	Gnode = 67, Extent = 3, Root = FALSE
S21-	77	DATA	Disk Logical Blocks: 460, 461, 462 Drive 13
S22-	78	DATA	Disk Logical Blocks: 671, 672, 673 Drive 15
S23-	79	PARITY	Disk Logical Blocks: 121, 122, 123 Drive 19
S24-	80	LINK	Index 88
	...	...	
S25-	88	GNODE	Gnode = 67, Extent = 3, Root = FALSE
S26-	89	DATA	Disk Logical Blocks: 463, 464, 465 Drive 13
S27-	90	DATA	Disk Logical Blocks: 674, 675, 676 Drive 15
S28-	91	PARITY	Disk Logical Blocks: 124, 125, 126 Drive 19
S29-	92	GNODE	Gnode = 43, Extent = 4, Root = FALSE
	...	...	

FIGURE 5 - Sample Portion of a Gee Table

Attribute Data	
602	File Attribute - type
604	File Attribute - mode
606	File Attribute - links
608	File Attribute - uid
610	File Attribute - gid
612	File Attribute - size
614	File Attribute - used
620	File Attribute - fileId
622	File Attribute - atime
624	File Attribute - mtime
626	File Attribute - ctime
628	Child Gnid Index
630	Gee Index - Last Used
631	Gee Offset - Last Used
632	Gee Index - Midpoint
633	Gee Offset - Midpoint
634	Gee Index - Tail
635	Gee Offset - Tail
636	Gee Index - Root
638	Gnode Status
640	Quick Shot Status
642	Quick Shot Link

600

FIGURE 6 - G-NODE ATTRIBUTES

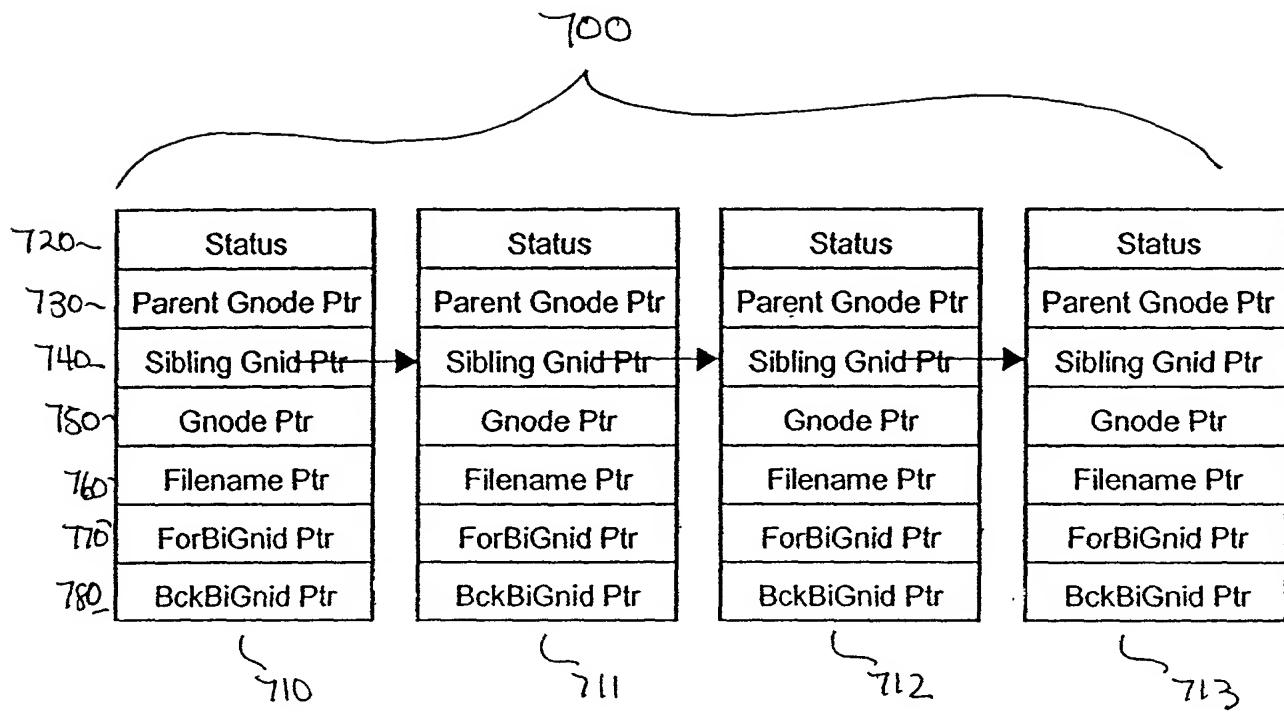


FIGURE 7- Structure of a Gnid String

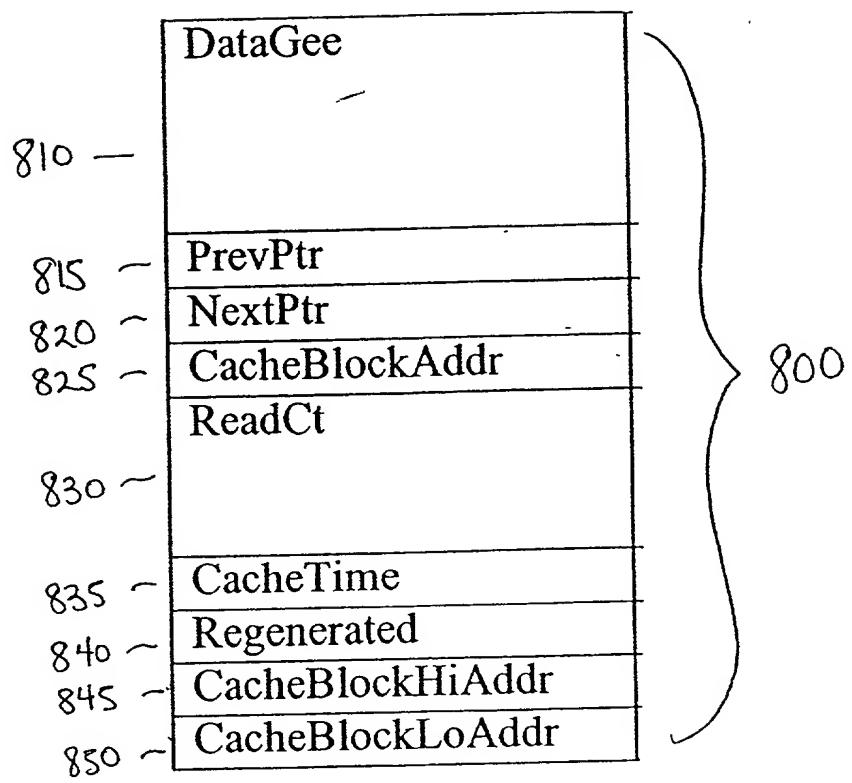


FIGURE 8a - Structure of a Cache Node

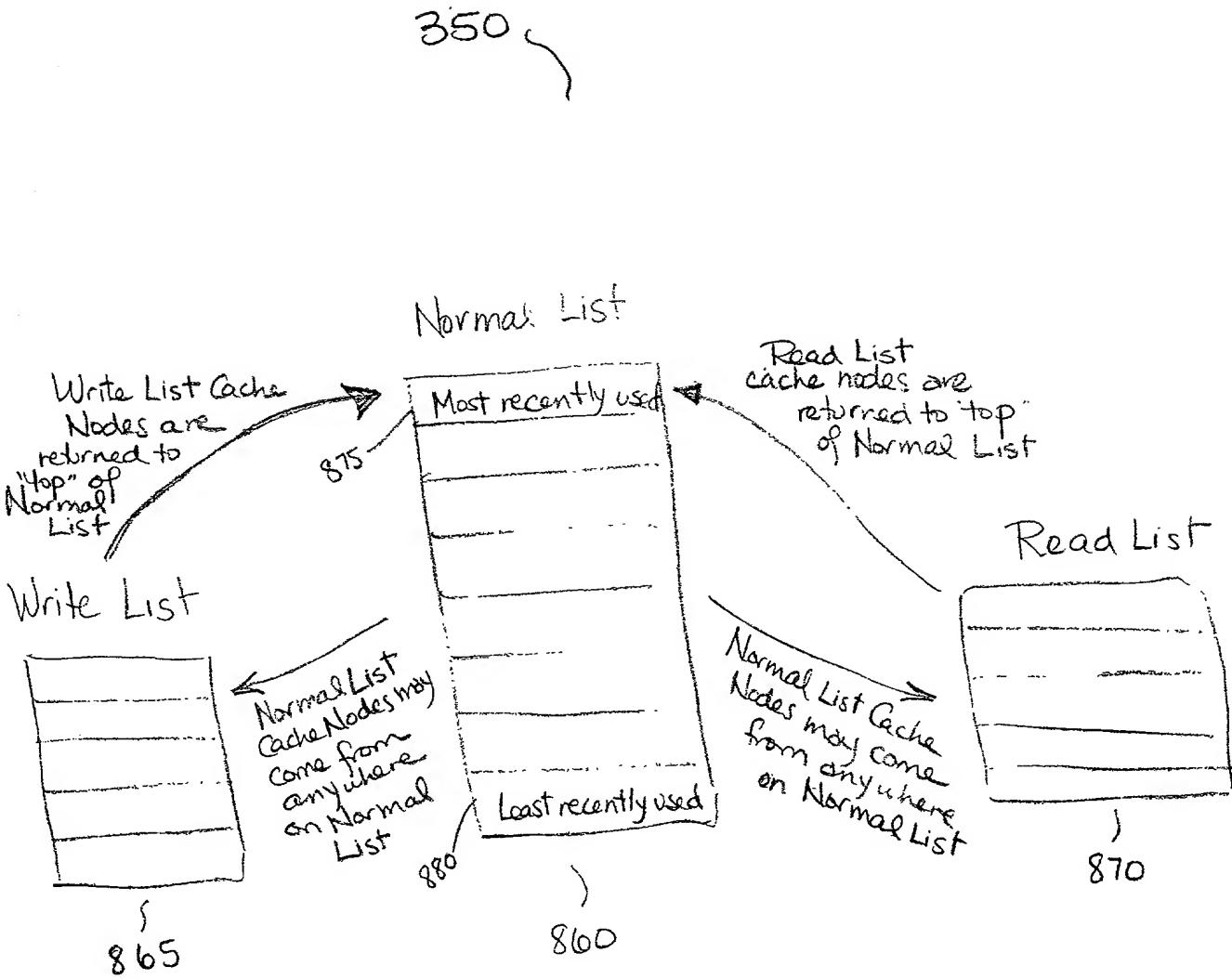


FIGURE 8B - Conceptual division of a Cache Node Table  
into Three Lists

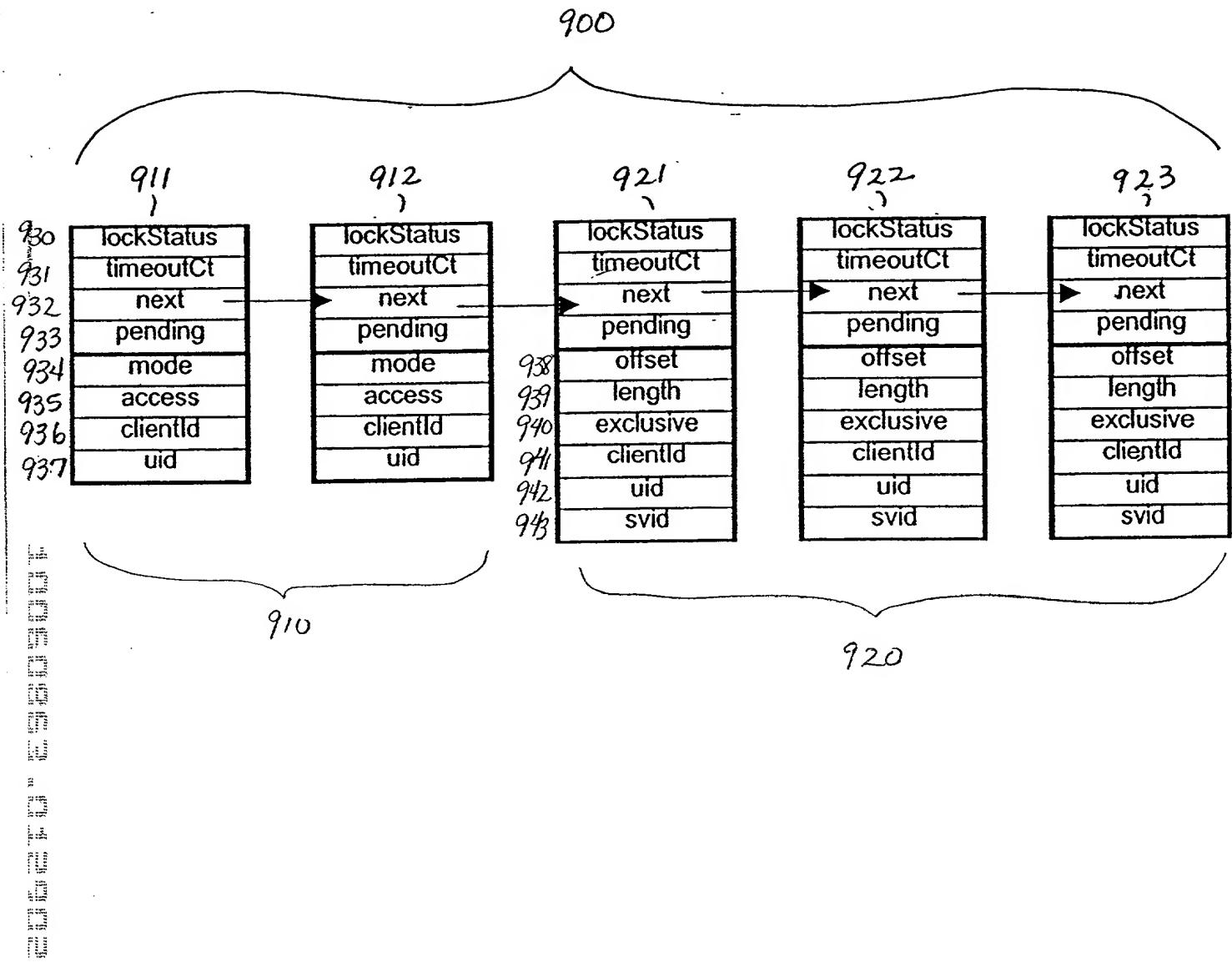


FIGURE 9 - A Sample Lock String

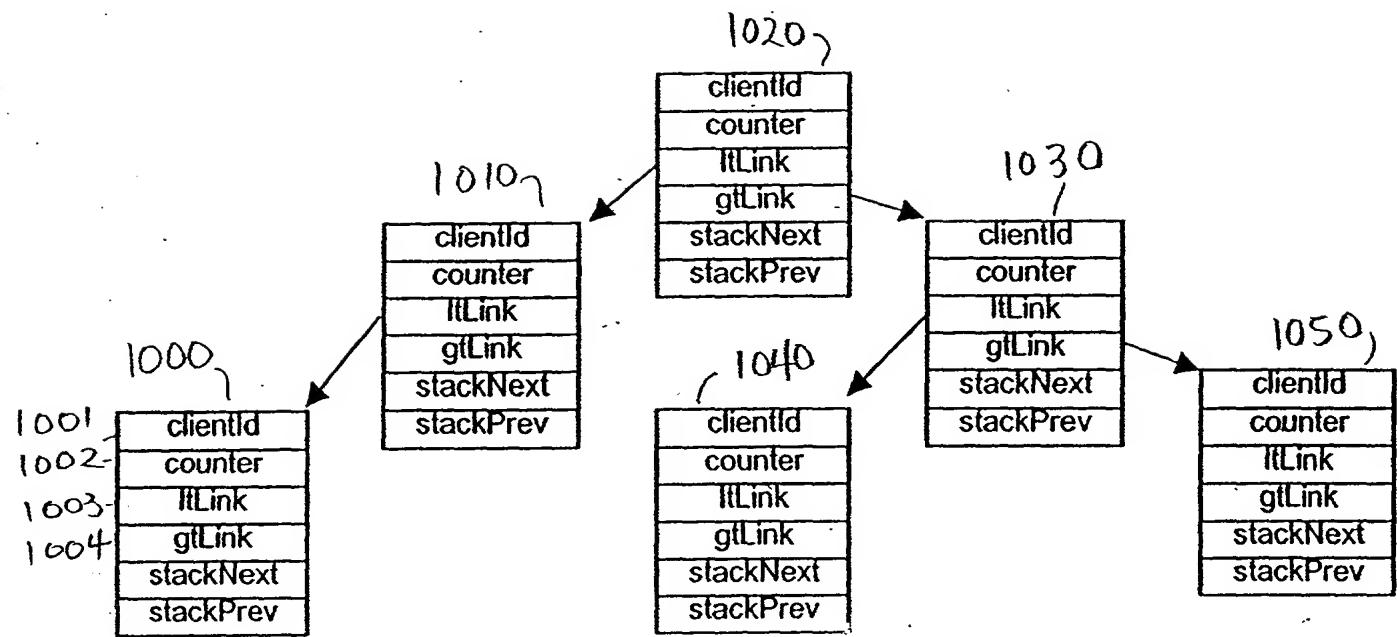


FIGURE 10 - Refresh Nodes configured as a binary tree.

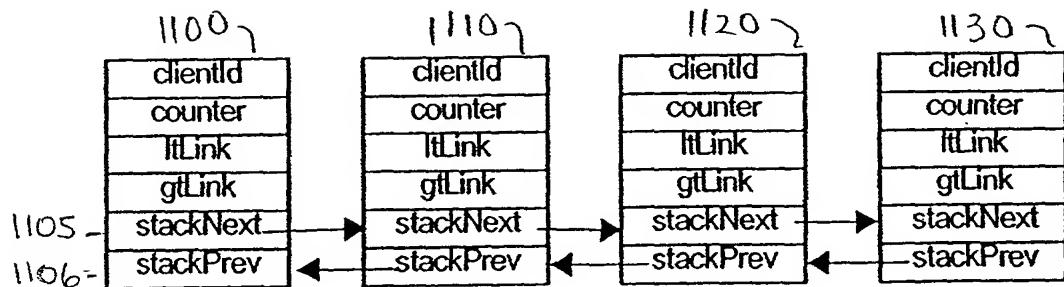


FIGURE 11 - RefreshNodes configured as a doubly-linked list

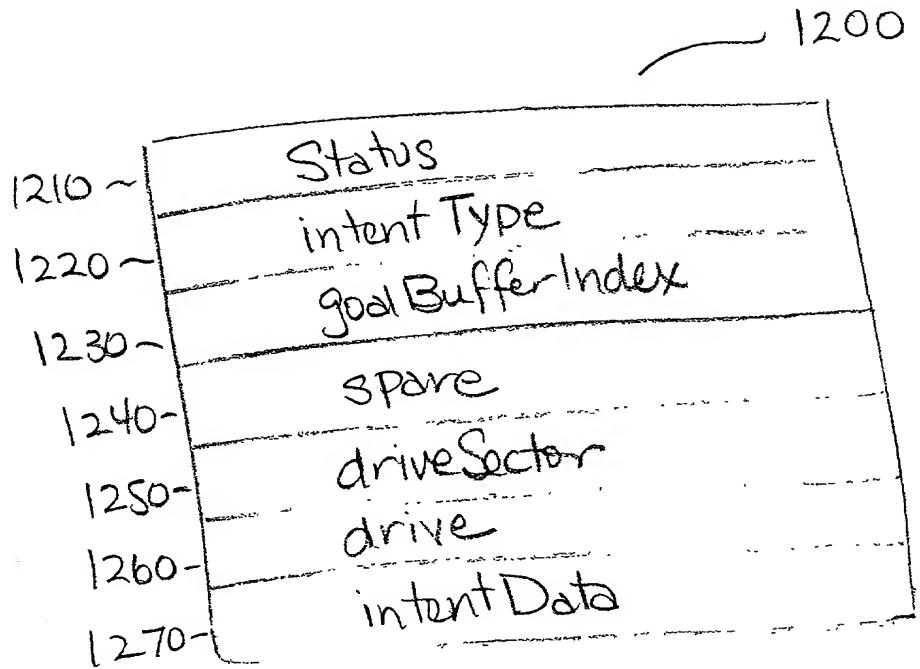


FIGURE 12 - Structure of an Intent Log Entry

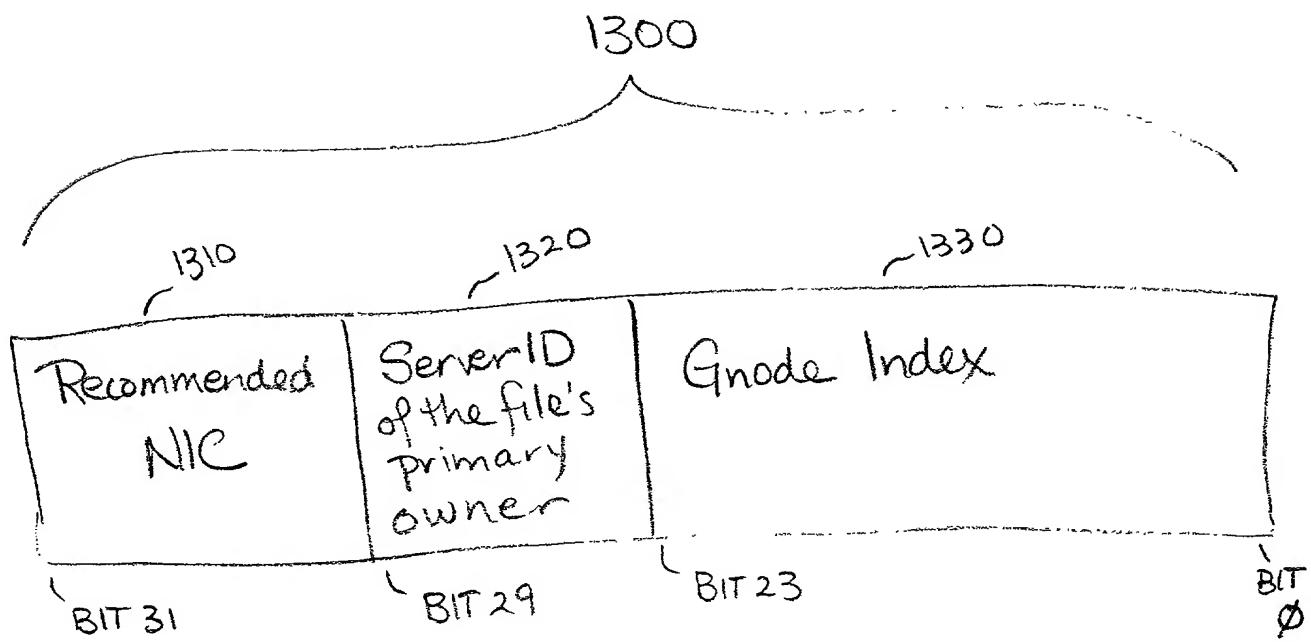


FIGURE 13 - Structure of a File Handle

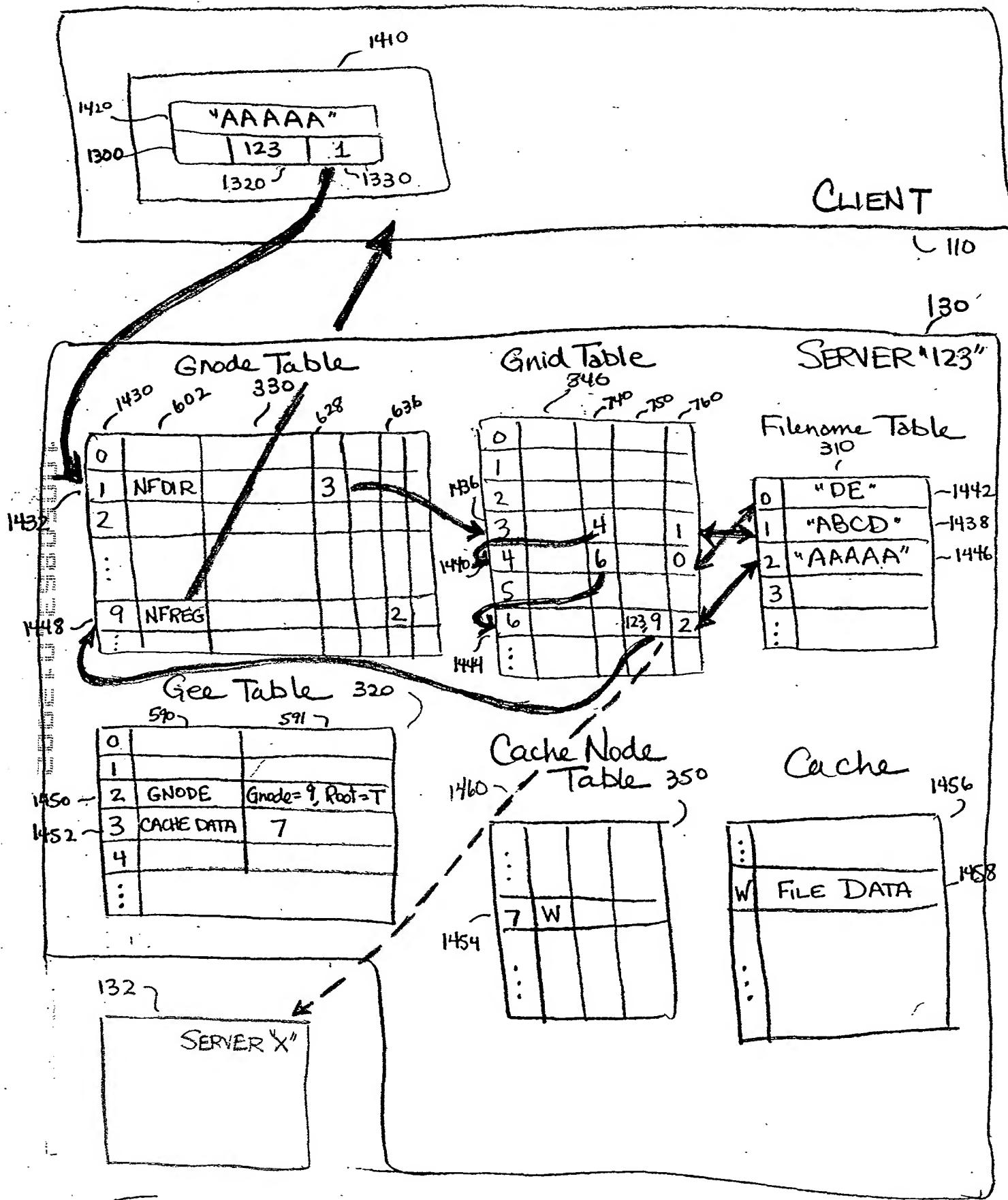


FIGURE 14a: Example of a File Look-up

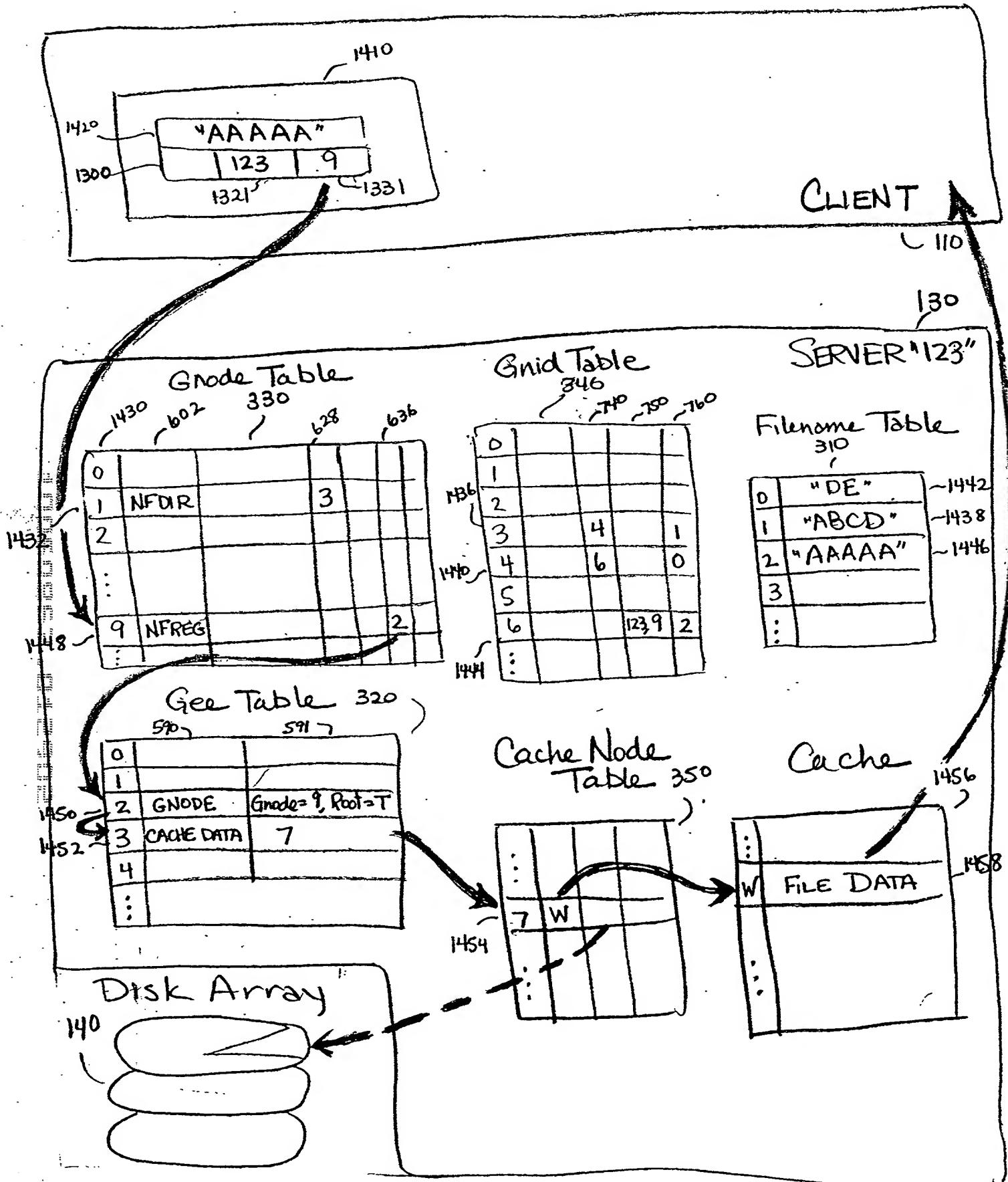


FIGURE 14b Example of a File Access

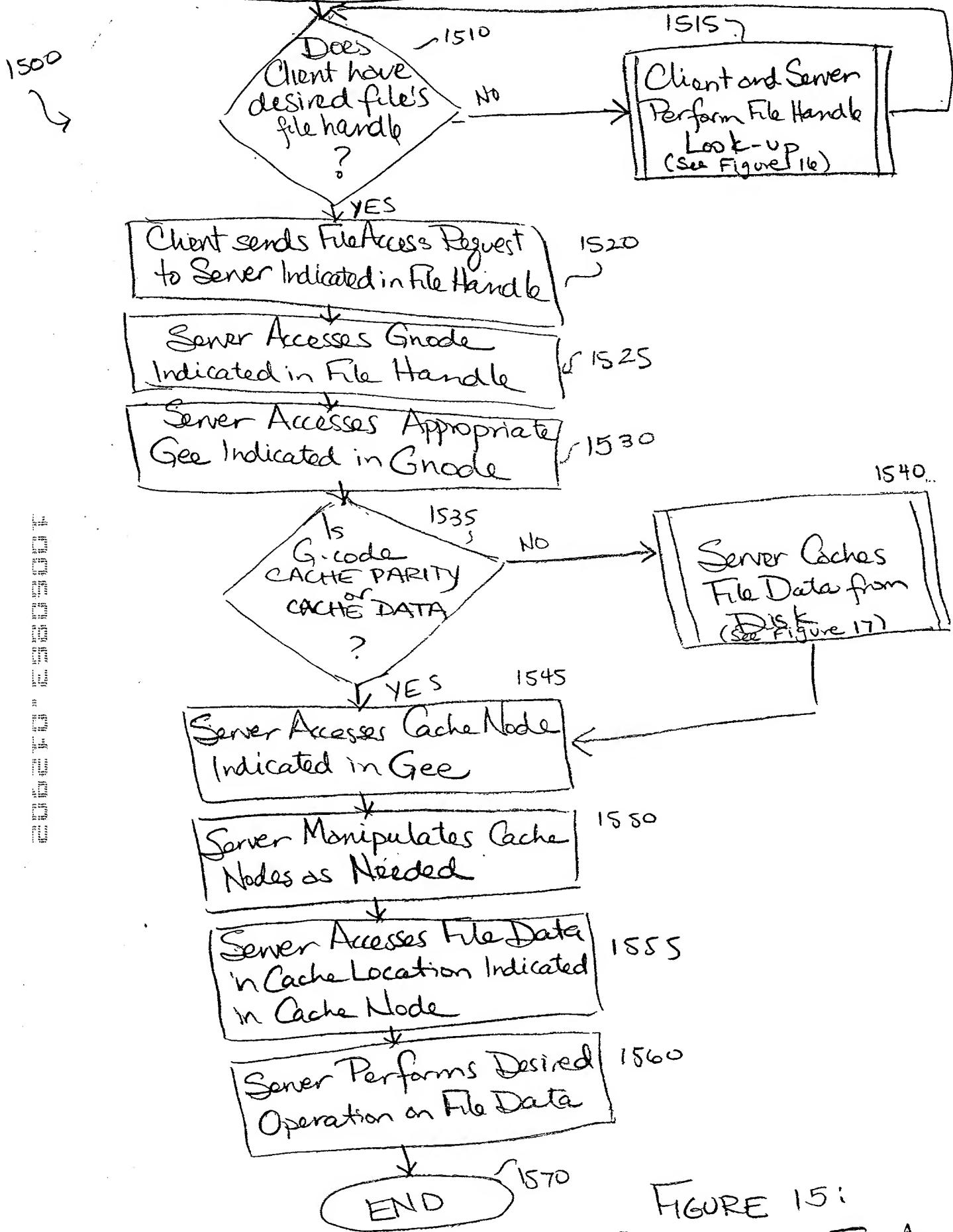


FIGURE 15:  
Performing a File Access

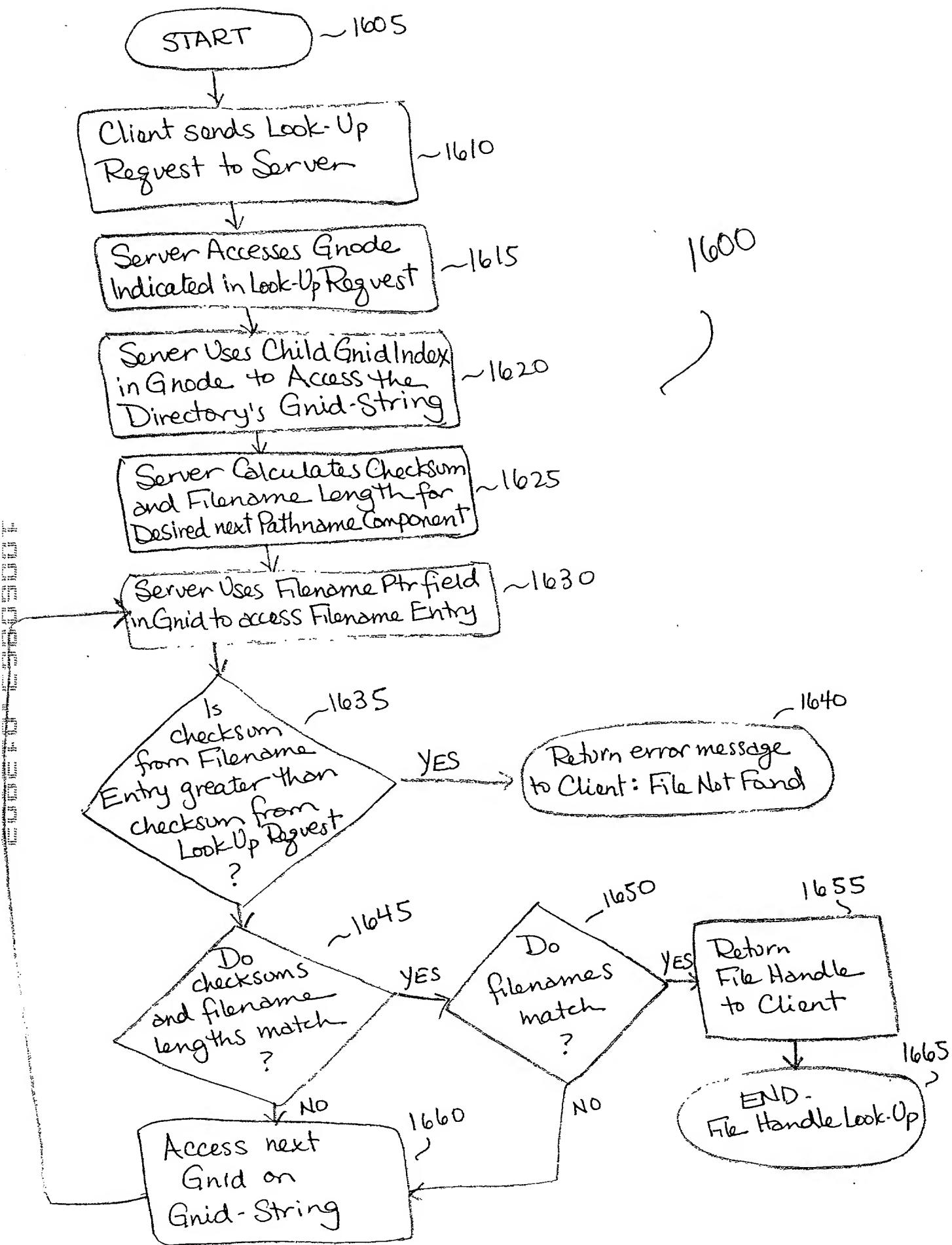


FIGURE 16 : Performing a File Handle Look-Up

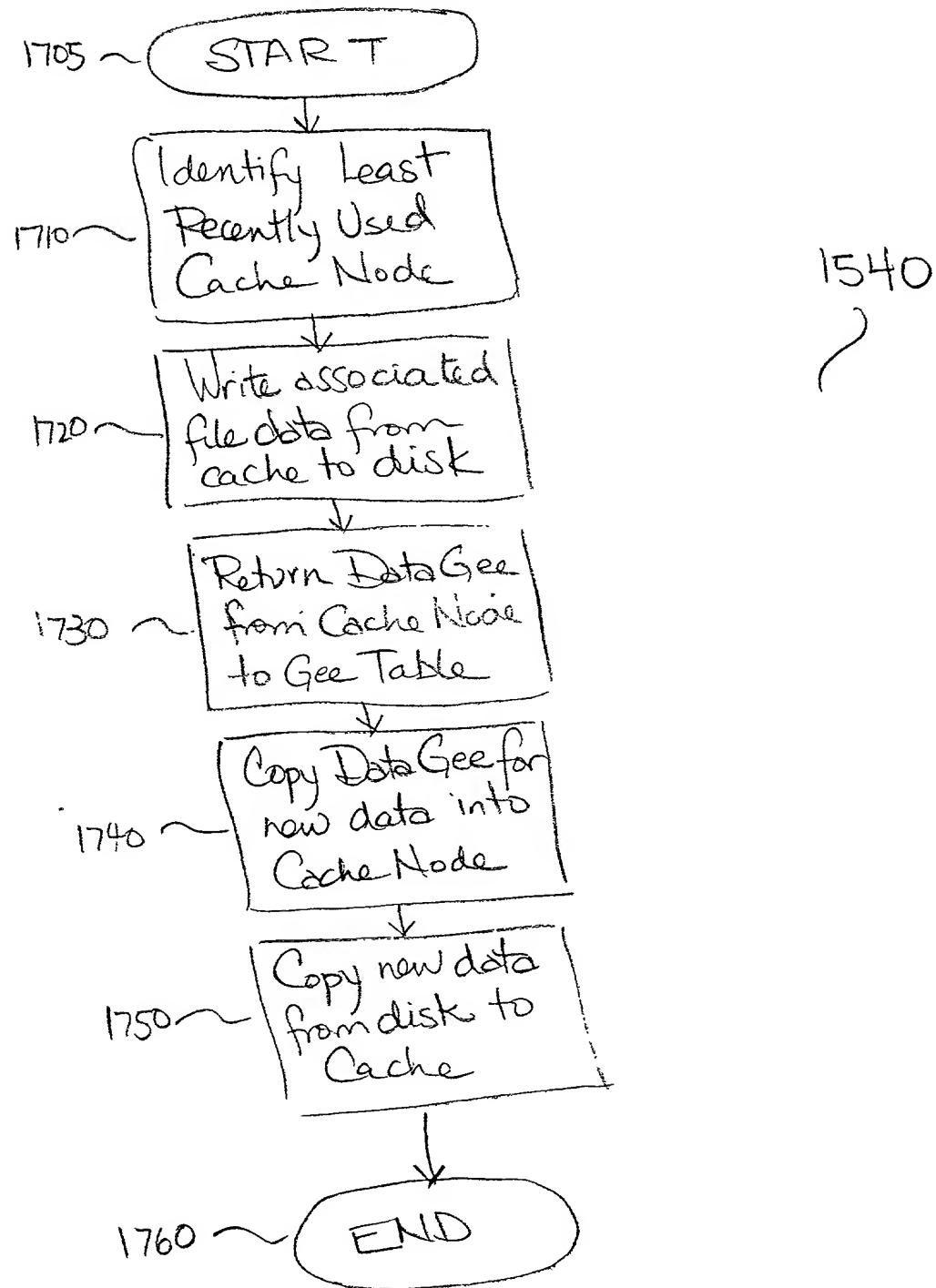


FIGURE 17: Caching File Data

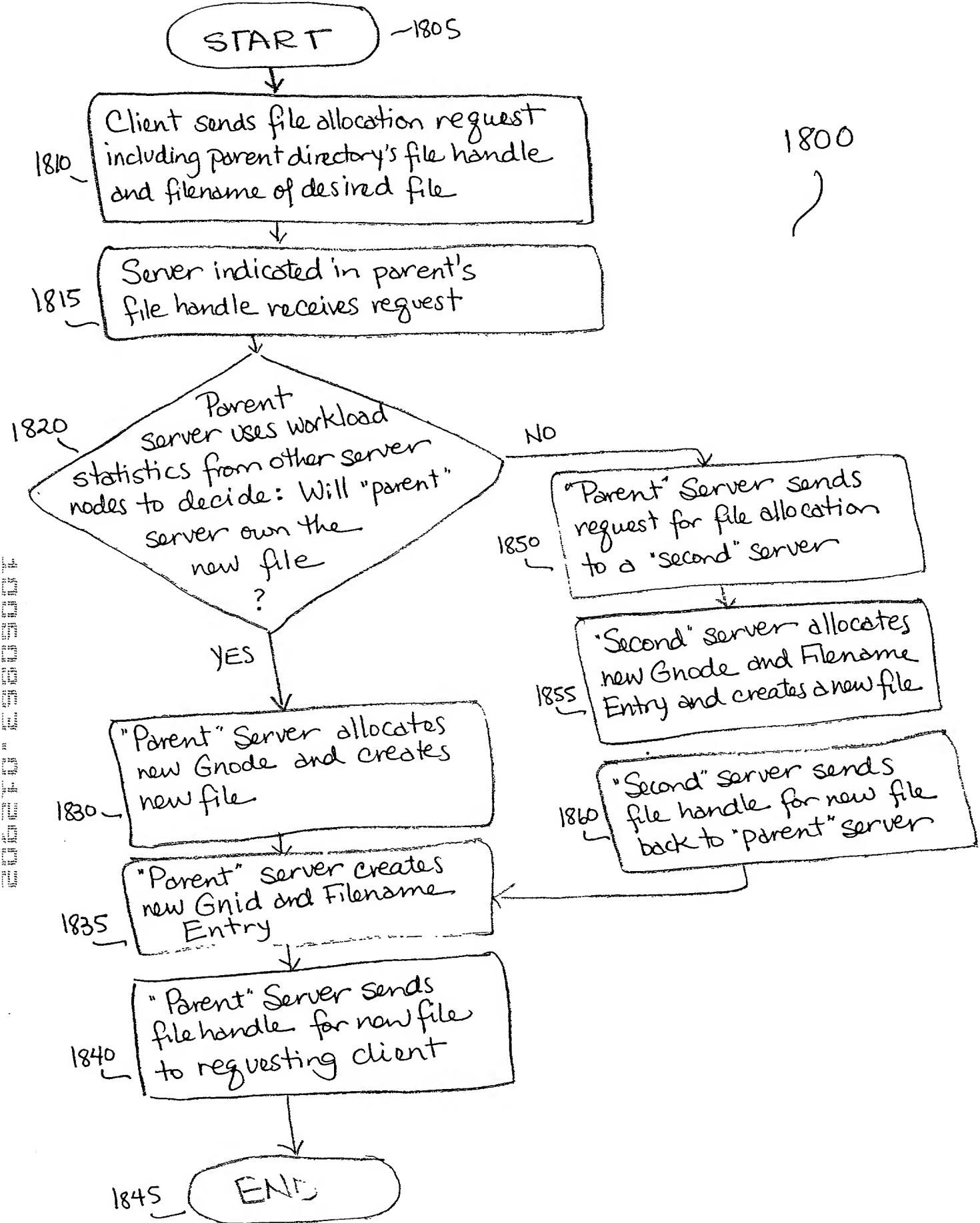


FIGURE 18 - File Allocation

- Gnode  
Redirectors  
(GNR)

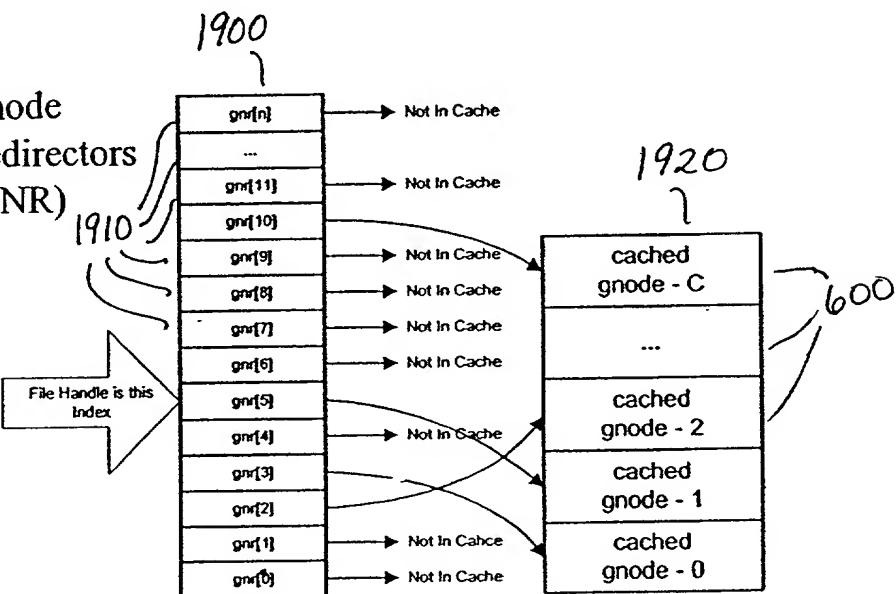


FIGURE 19

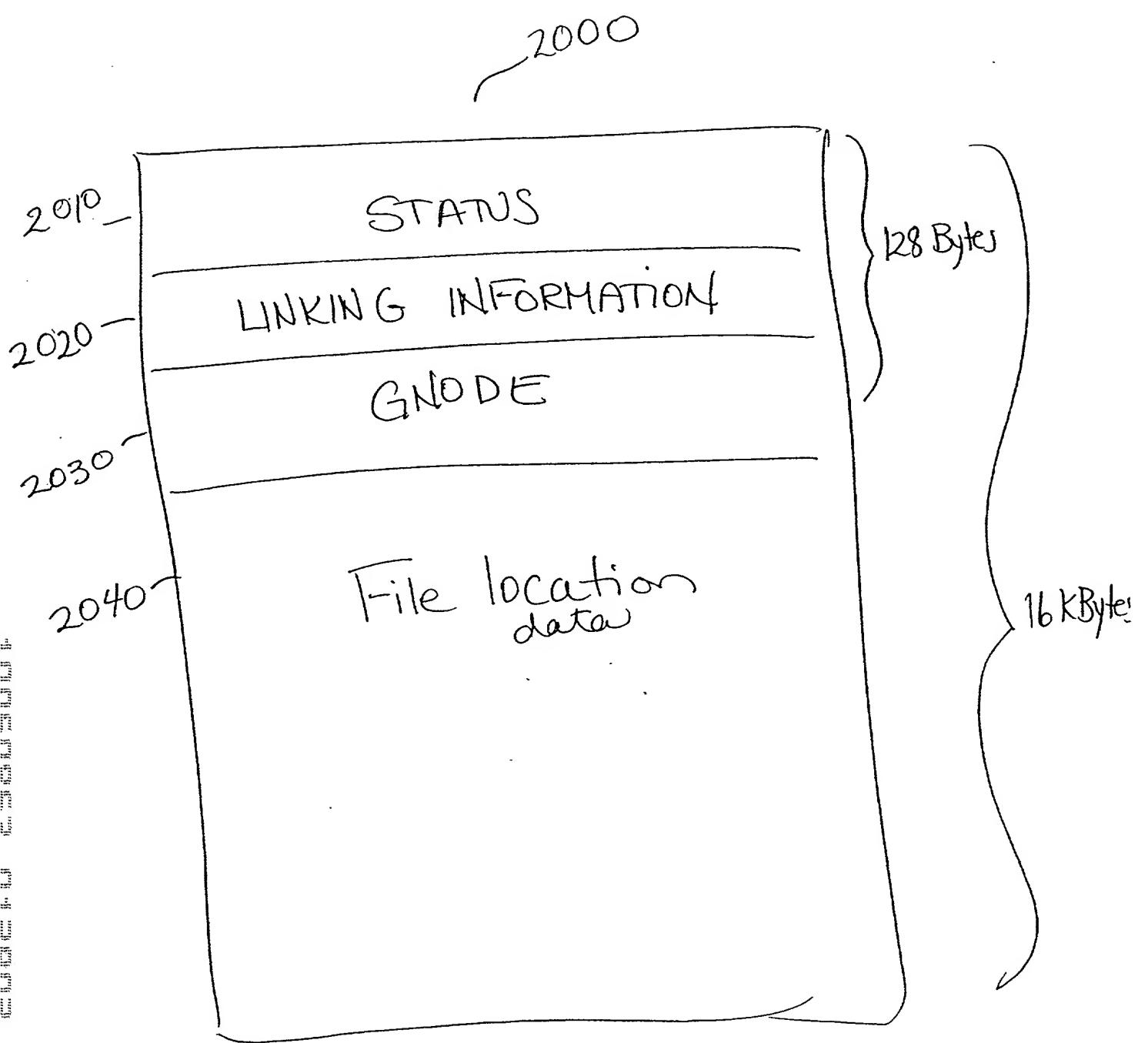


Figure 20a

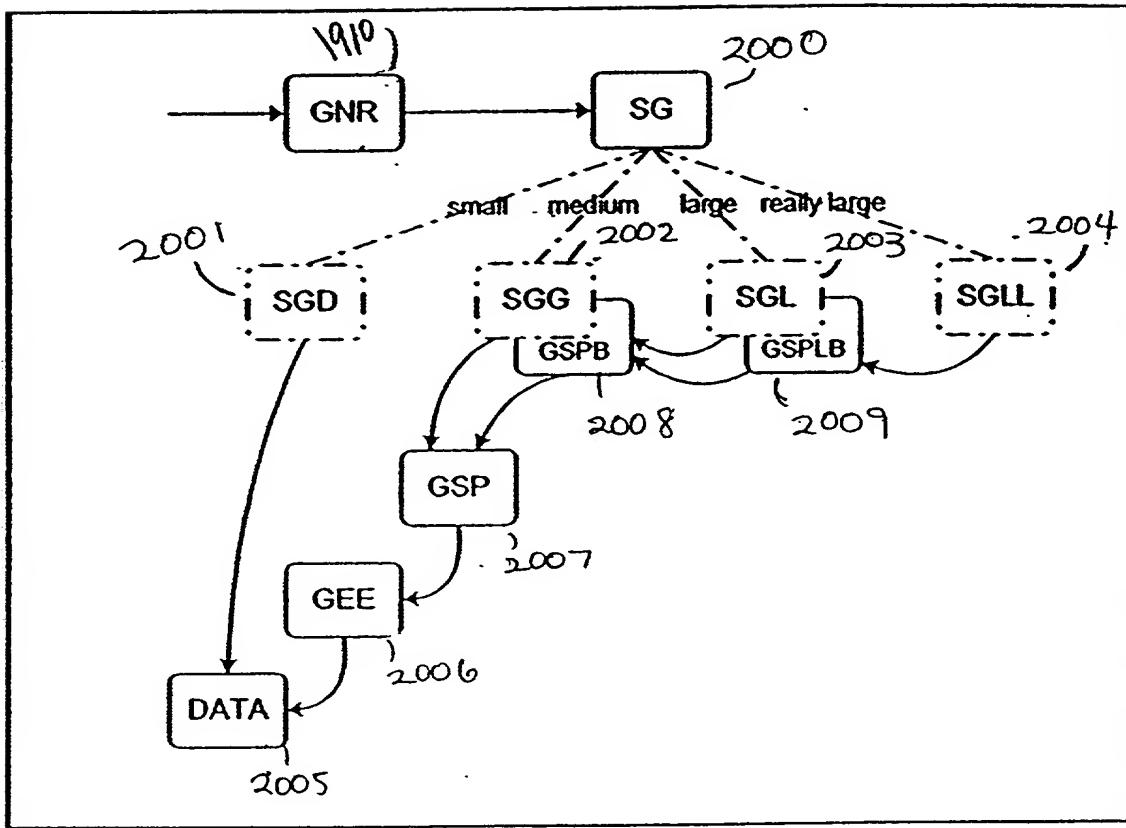


FIGURE 20b

CONVENTIONAL RAID MAPPING  
(PRIOR ART)

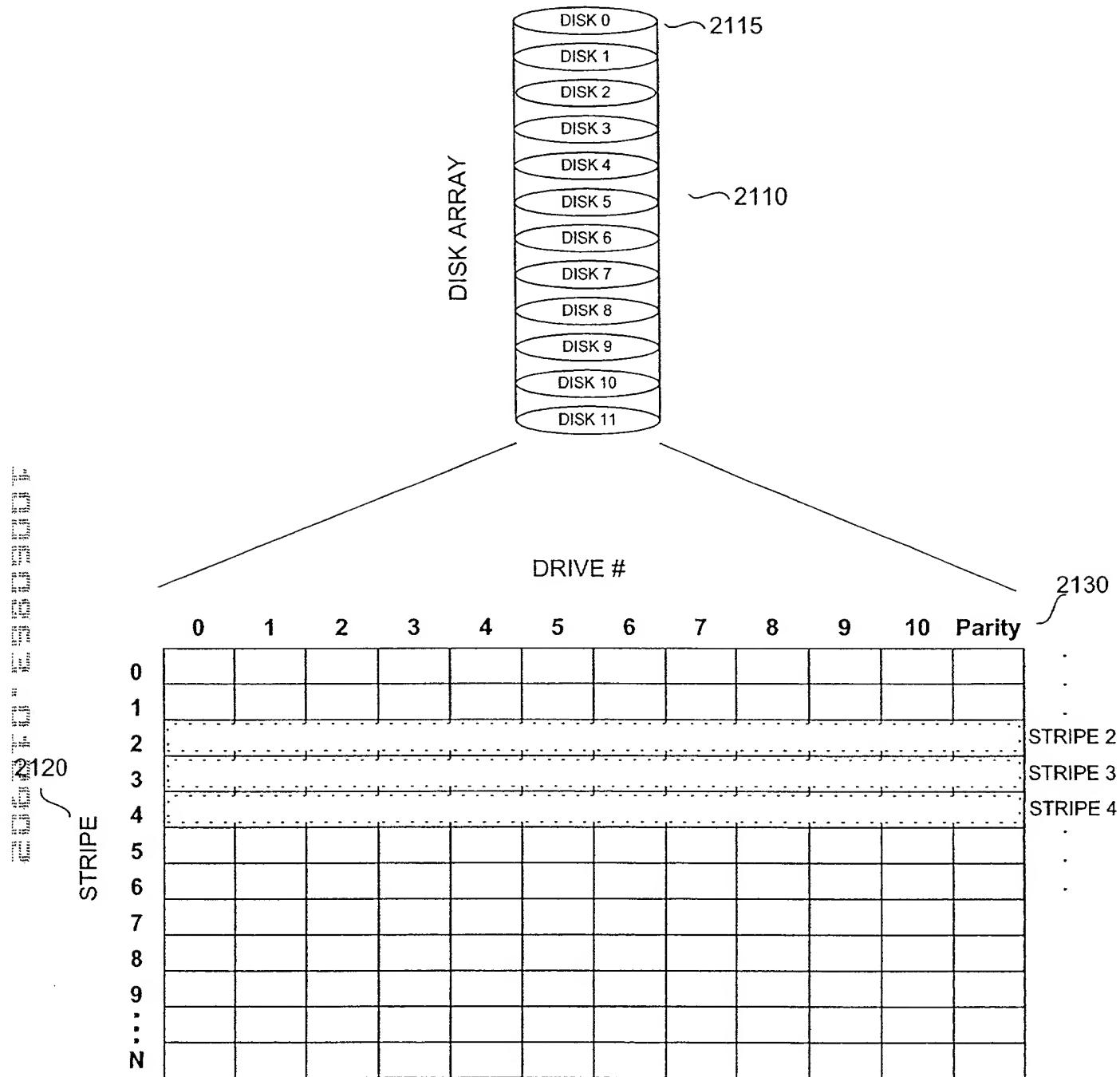


FIGURE 21

FIGURE 22A

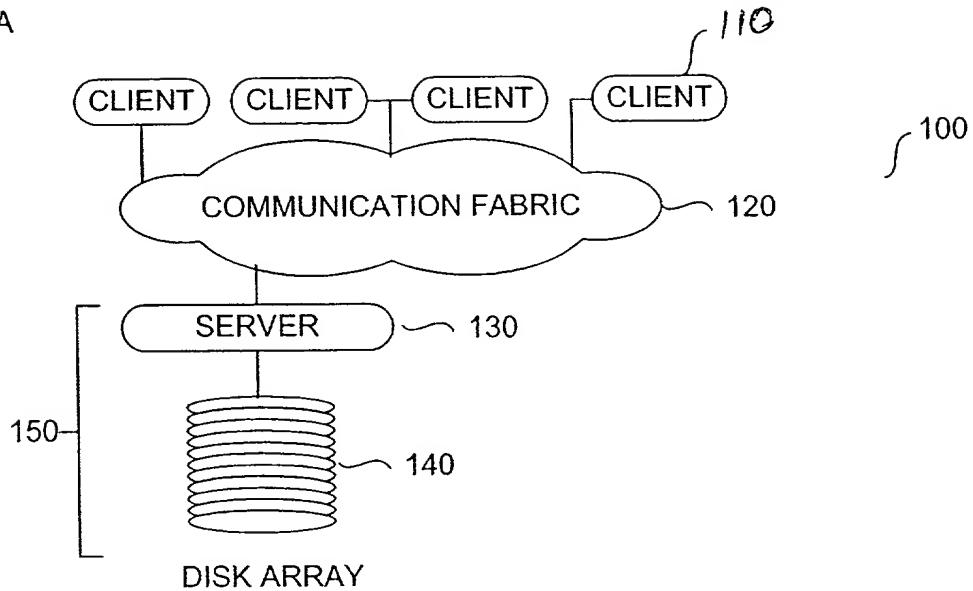


FIGURE 22B

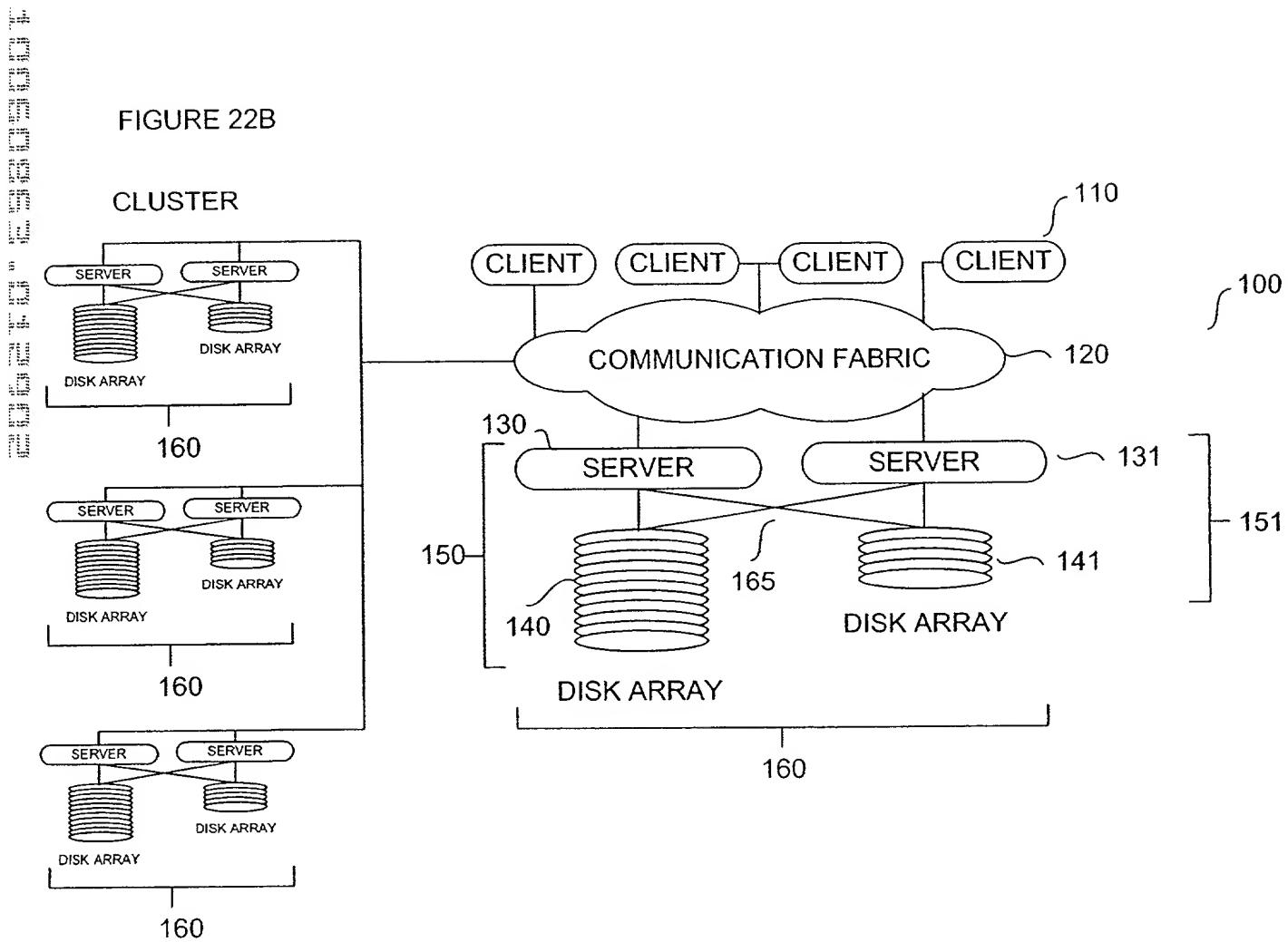


FIGURE 23

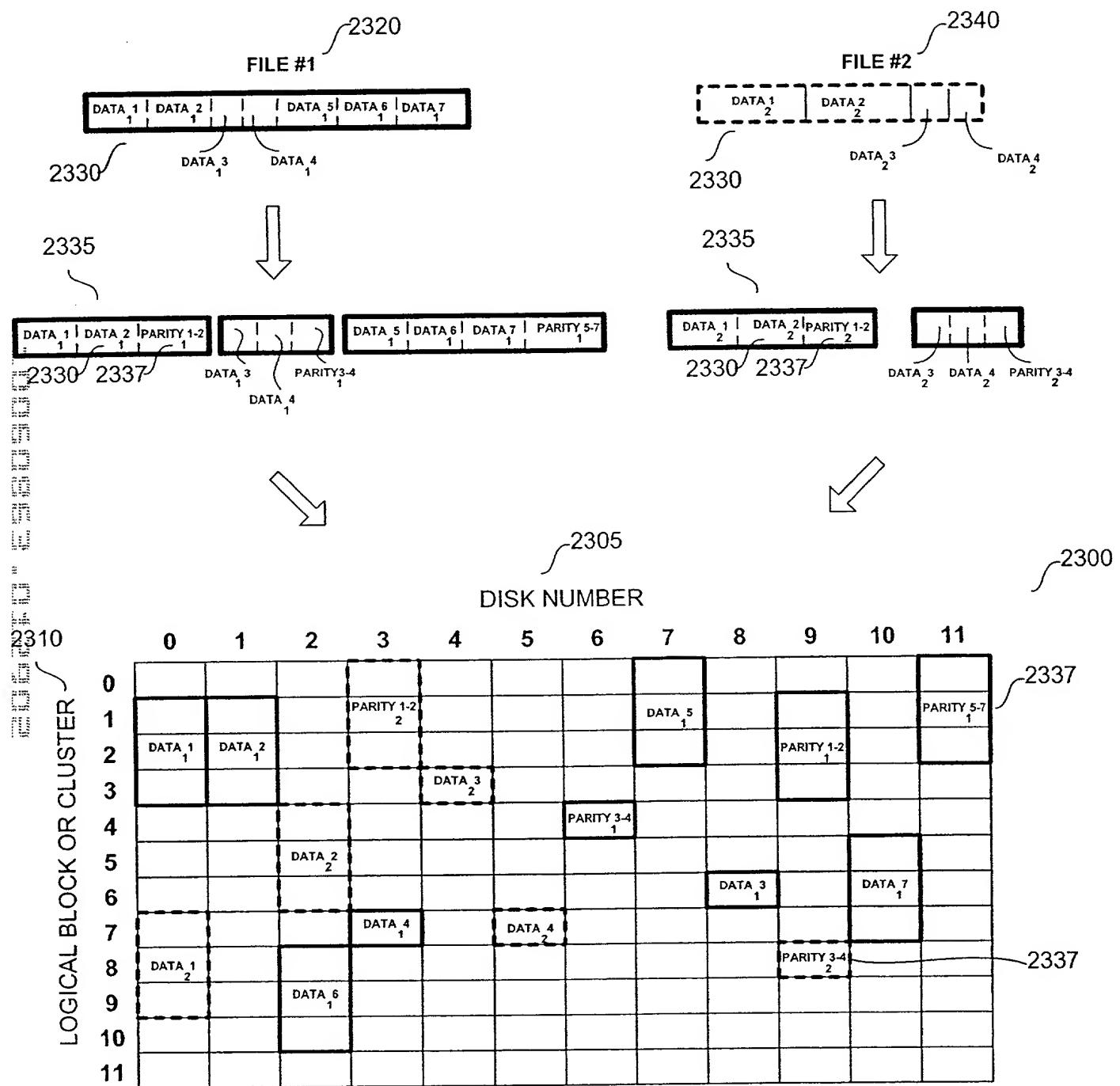


FIGURE 24A

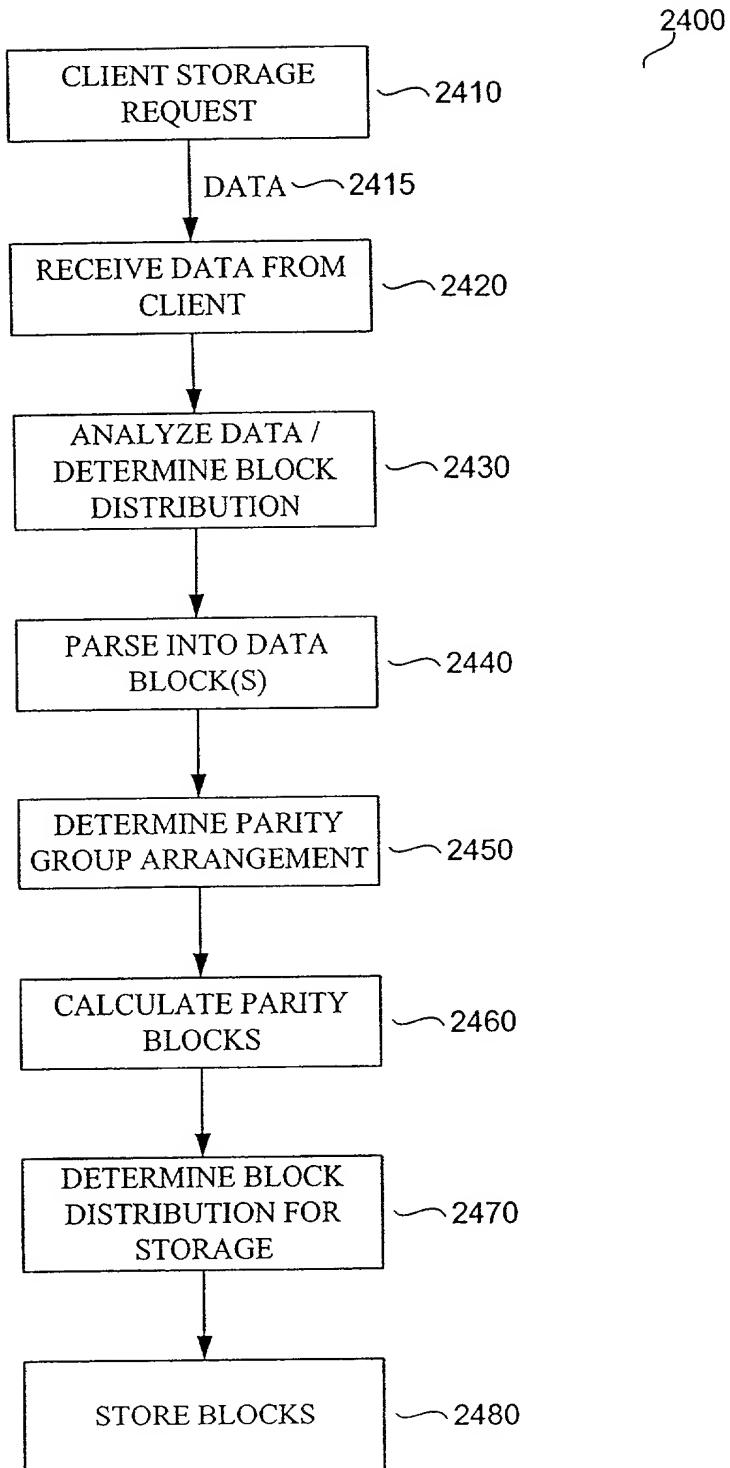


FIGURE 24B

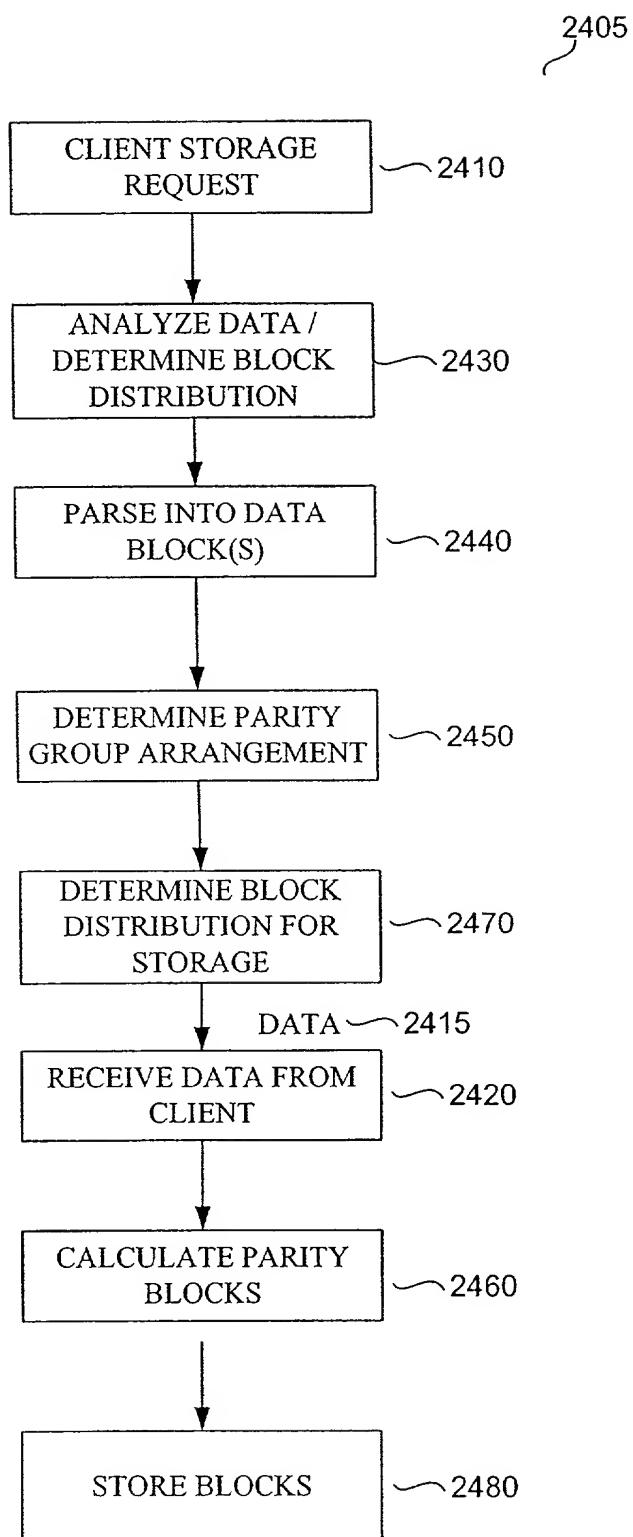


FIGURE 25

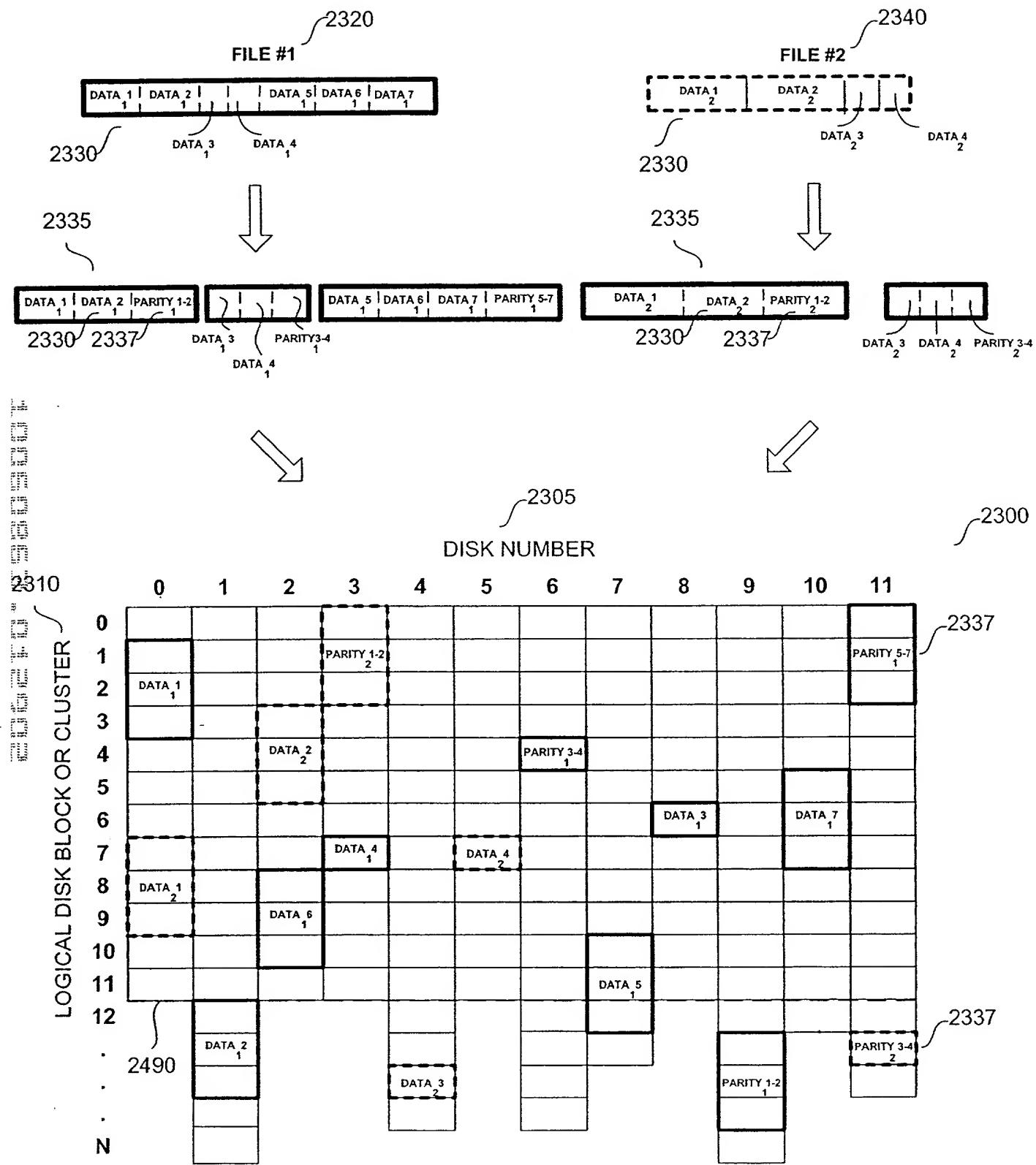


FIGURE 26A

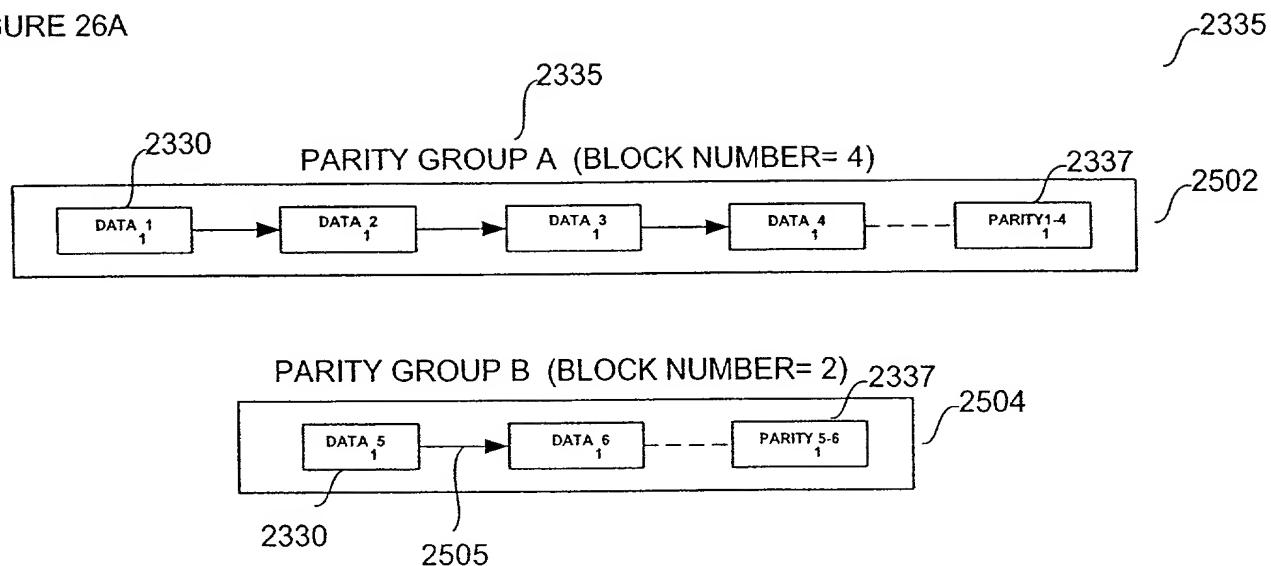
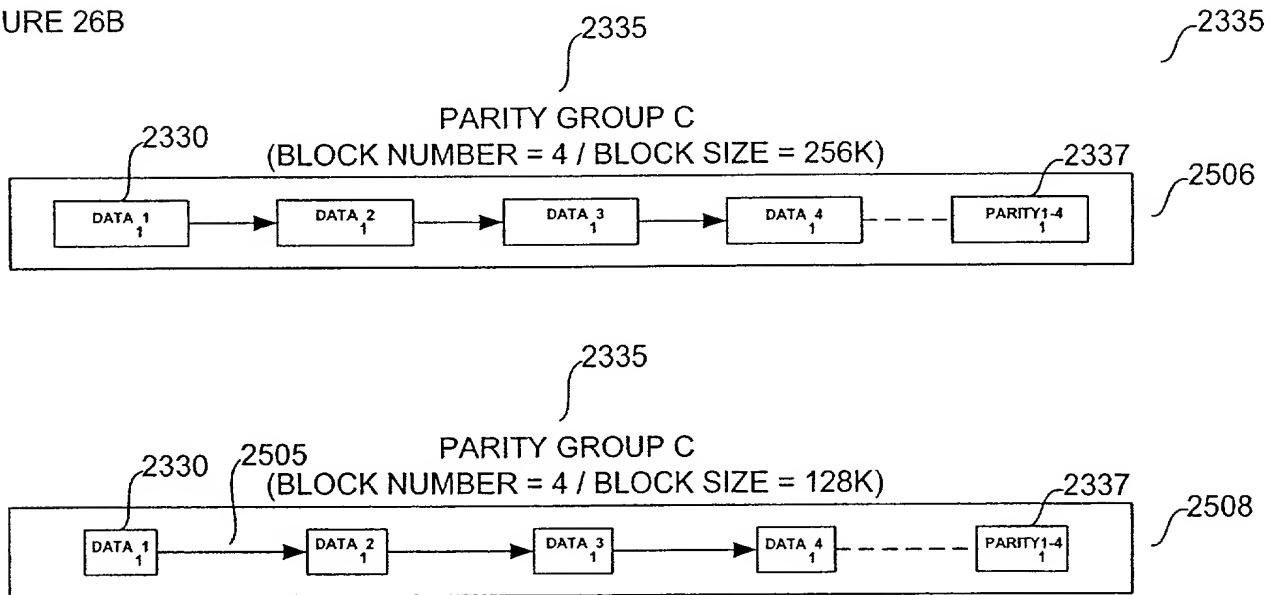


FIGURE 26B



DISK ARRAY INITIALIZATION USING GEE TABLE  
SPACE ALLOCATION

2530

INDEX	G-CODE	DATA	
45	GNODE	EXTENT=2	2542
46	DATA	BLOCKS 456, 457: Drive 13	
47	DATA	BLOCKS 667, 668: Drive 15	
48	DATA	BLOCKS 112, 113: Drive 19	
49	PARITY	BLOCKS 554, 555: Drive 2	
...	...	...	
76	GNODE	EXTENT=3	2540
77	DATA	BLOCKS 460, 461, 462: Drive 13	
78	DATA	BLOCKS 671, 672, 673: Drive 15	
79	PARITY	BLOCKS 121, 122, 123: Drive 19	
...	...	...	
88	GNODE	EXTENT=2	2540
89	DATA	BLOCKS 463, 464, 465: Drive 2	
90	DATA	BLOCKS 674, 675, 676: Drive 5	
91	PARITY	BLOCKS 124, 125, 126: Drive 13	
...			

FIGURE 27

## ARRAY PREPARATION / G-TABLE FORMATTING

~ 2448

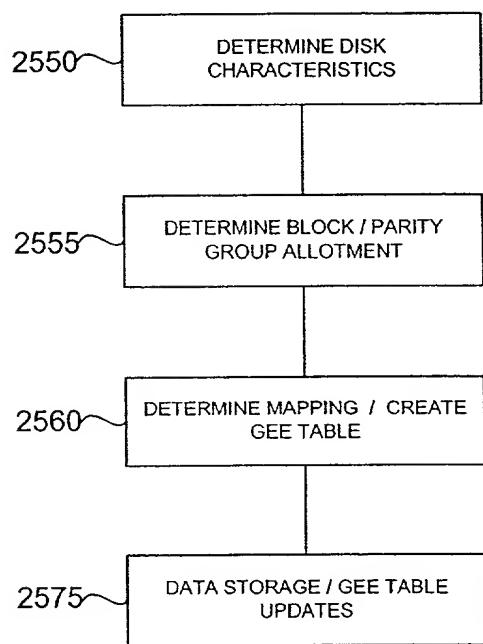


FIGURE 28

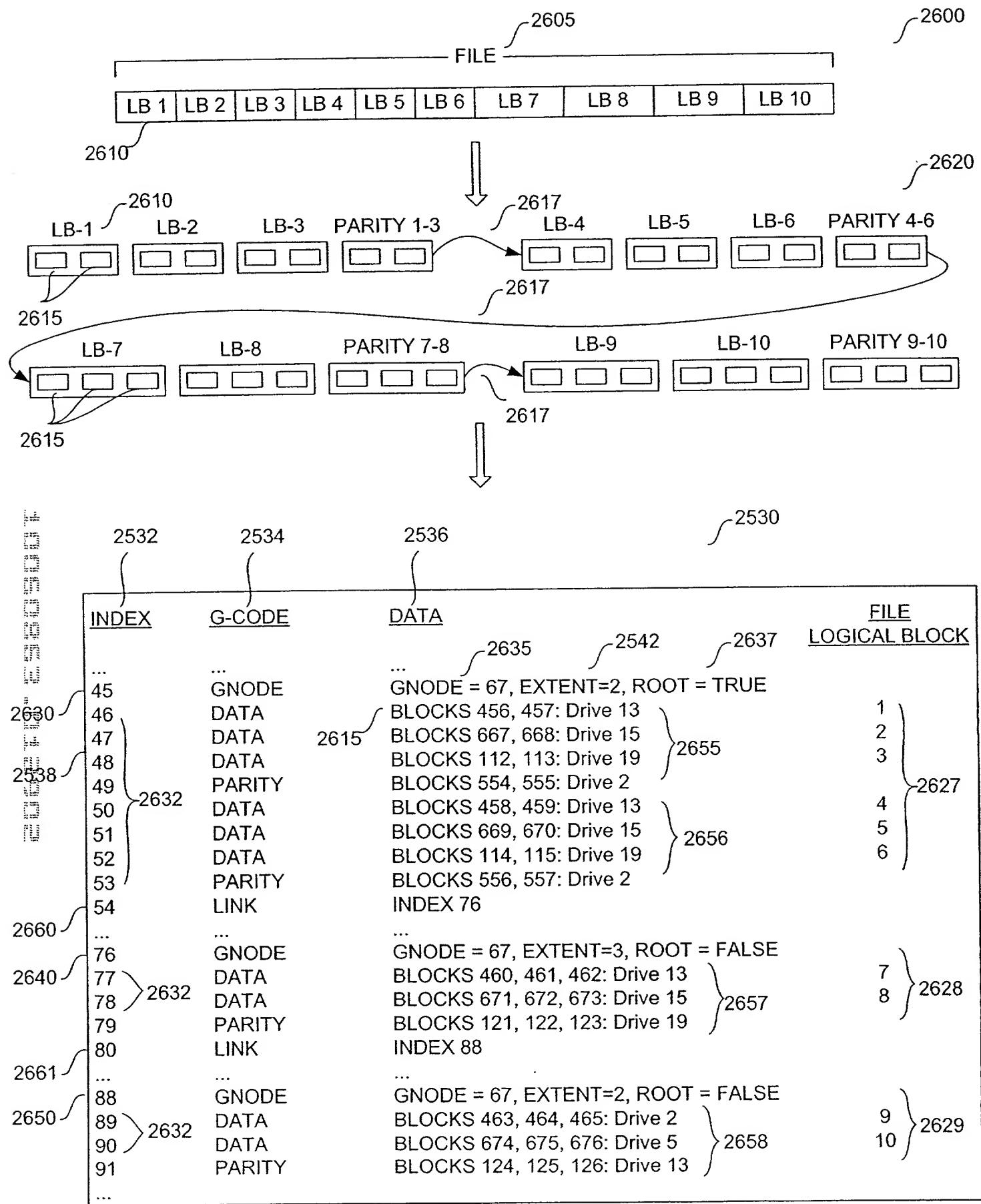


FIGURE 29

### DRIVE FAILURE RECOVERY MECHANISM

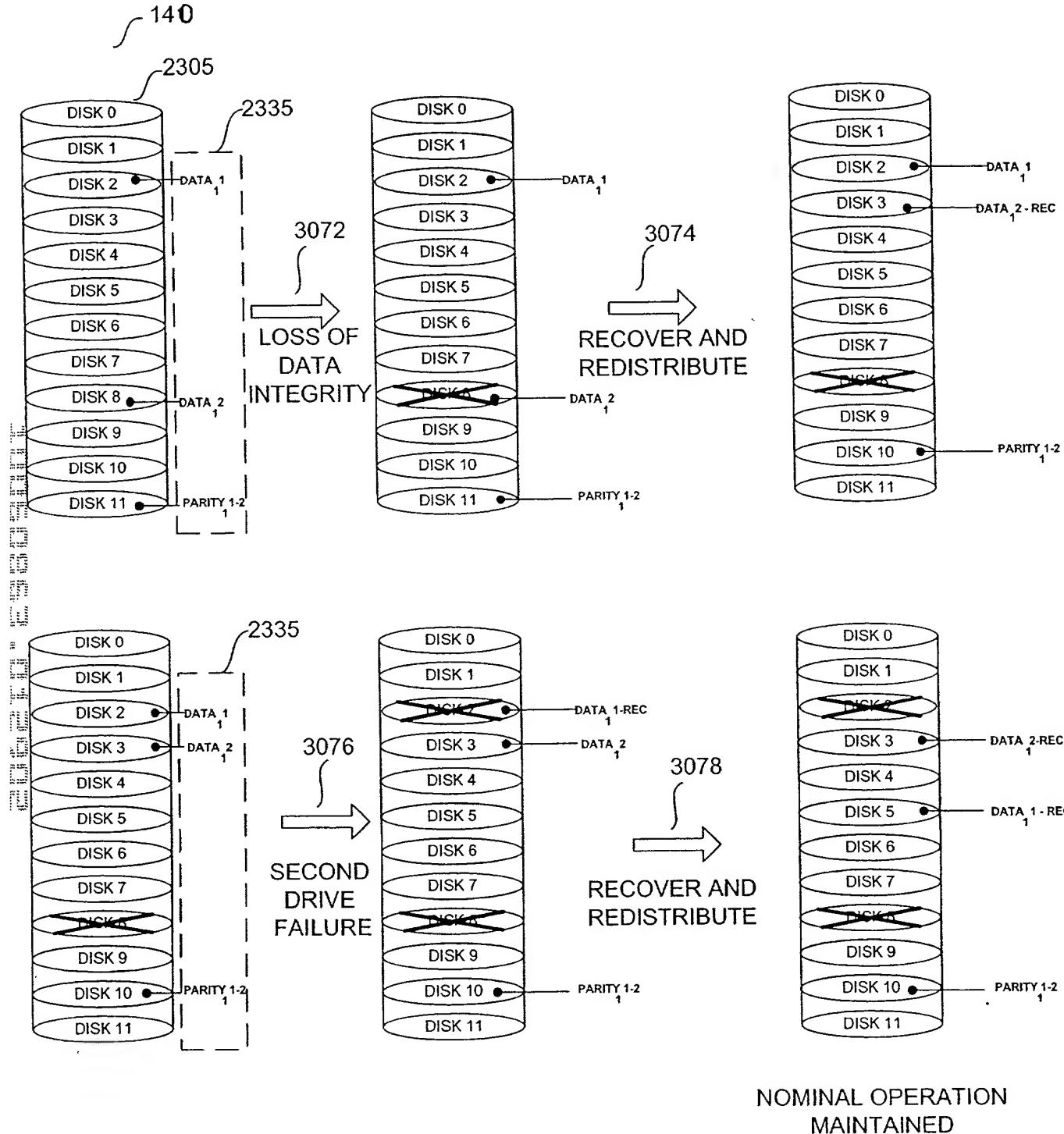


FIGURE 30

DATA RECOVERY  
PROCESS

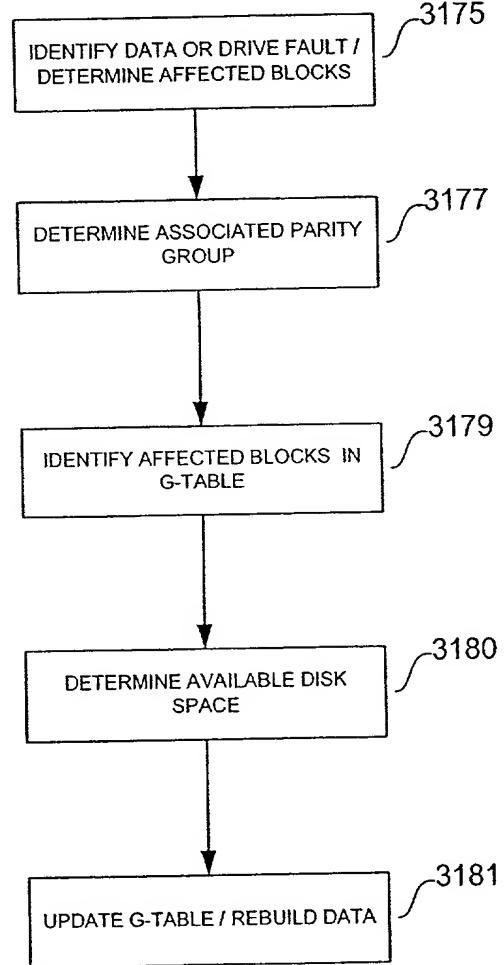
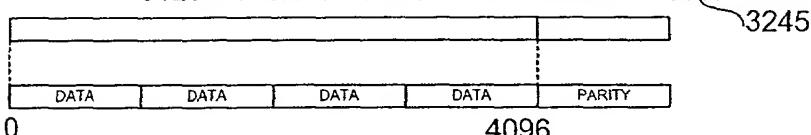


FIGURE 31

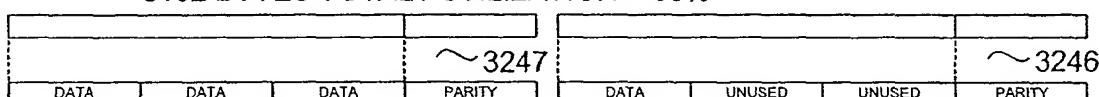
**FIGURE 32A**

FILE #1

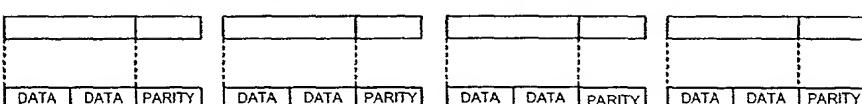
FILE #1 W/ PARITY -- 4-BLOCK PARITY GROUP -- EXTENT = 2  
5120 BYTES TOTAL / UTILIZATION = 100%



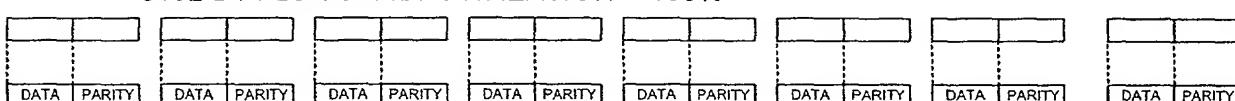
FILE #1 W/ PARITY -- 3-BLOCK PARITY GROUP -- EXTENT = 2  
8192 BYTES TOTAL / UTILIZATION = 66%



FILE #1 W/ PARITY -- 2-BLOCK PARITY GROUP -- EXTENT = 1  
6144 BYTES TOTAL / UTILIZATION = 100%



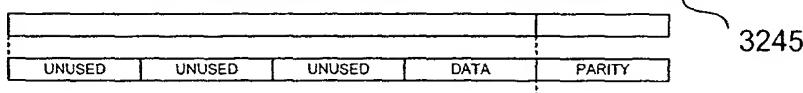
FILE #1 W/ PARITY -- 1-BLOCK PARITY GROUP -- EXTENT = 1  
8192 BYTES TOTAL / UTILIZATION = 100%



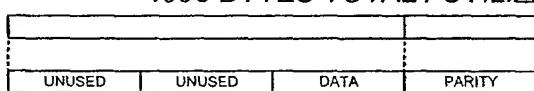
**FIGURE 32B**

FILE #2  
0 1024

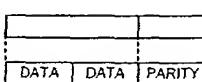
FILE #2 W/ PARITY -- 4-BLOCK PARITY GROUP -- EXTENT = 2  
5120 BYTES TOTAL / UTILIZATION = 25%



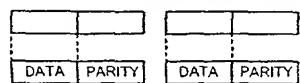
FILE #2 W/ PARITY -- 3-BLOCK PARITY GROUP -- EXTENT = 2  
4096 BYTES TOTAL / UTILIZATION = 33%



FILE #2 W/ PARITY -- 2-BLOCK PARITY GROUP -- EXTENT = 1  
1536 BYTES TOTAL / UTILIZATION = 100%



FILE #2 W/ PARITY -- 1-BLOCK PARITY GROUP -- EXTENT = 1  
2048 BYTES TOTAL / UTILIZATION = 100%



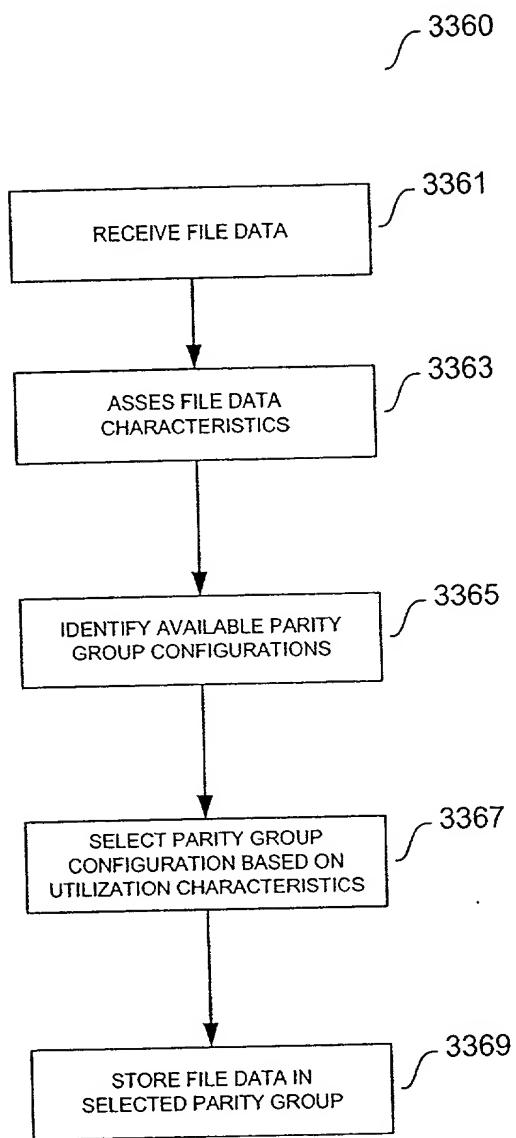


FIGURE 33

FIGURE 34A

INITIAL ALLOCATION					DISK SPACE %
[DATA DATA DATA DATA PARITY]	4 block parity ↗ 3480	10000 groups			36%
[DATA DATA DATA PARITY]	3 block parity ↗ 3481	10000 groups			28%
[DATA DATA PARITY]	2 block parity ↗ 3482	10000 groups			22%
[DATA PARITY]	1 block parity ↗ 3483	10000 groups			14%



FIGURE 34B

	FREE	OCCUPIED	TOTAL	DISK SPACE %
3480 ↗ 4 block parity	2500 groups	7500 groups	10000 groups	36%
3481 ↗ 3 block parity	7500 groups	2500 groups	10000 groups	28%
3482 ↗ 2 block parity	3500 groups	6500 groups	10000 groups	22%
3483 ↗ 1 block parity	500 groups	9500 groups	10000 groups	14%



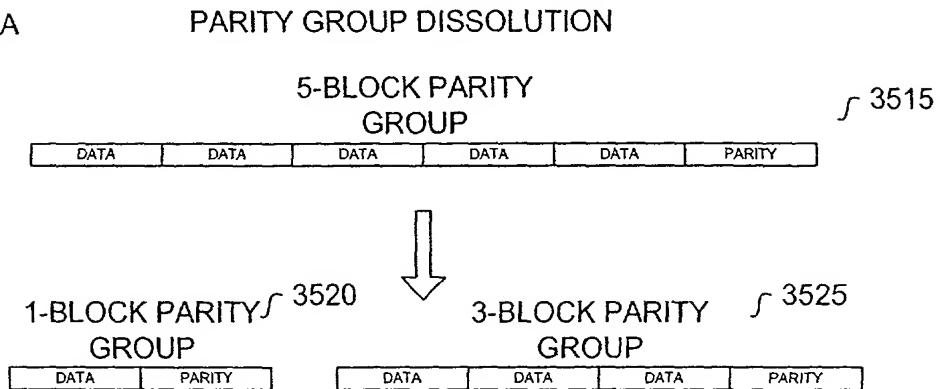
FIGURE 34C

	FREE	OCCUPIED	TOTAL	DISK SPACE %
3480 ↗ 4 block parity	2500 groups	7500 groups	10000 groups	36%
3481 ↗ 3 block parity	-5000 groups of 3 block parity	2500 groups	5000 groups	14%
3482 ↗ 2 block parity	+10000 groups of 1 block parity	3500 groups	10000 groups	22%
3483 ↗ 1 block parity		10500 groups	20000 groups	28%

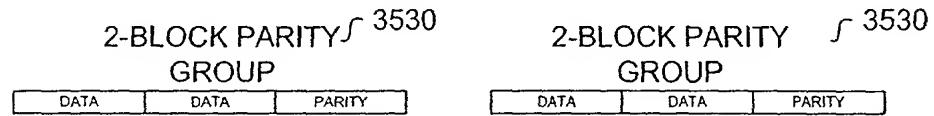
REDISTRIBUTION

FIGURE 35A

PARITY GROUP REDISTRIBUTION PROCESSES



OR

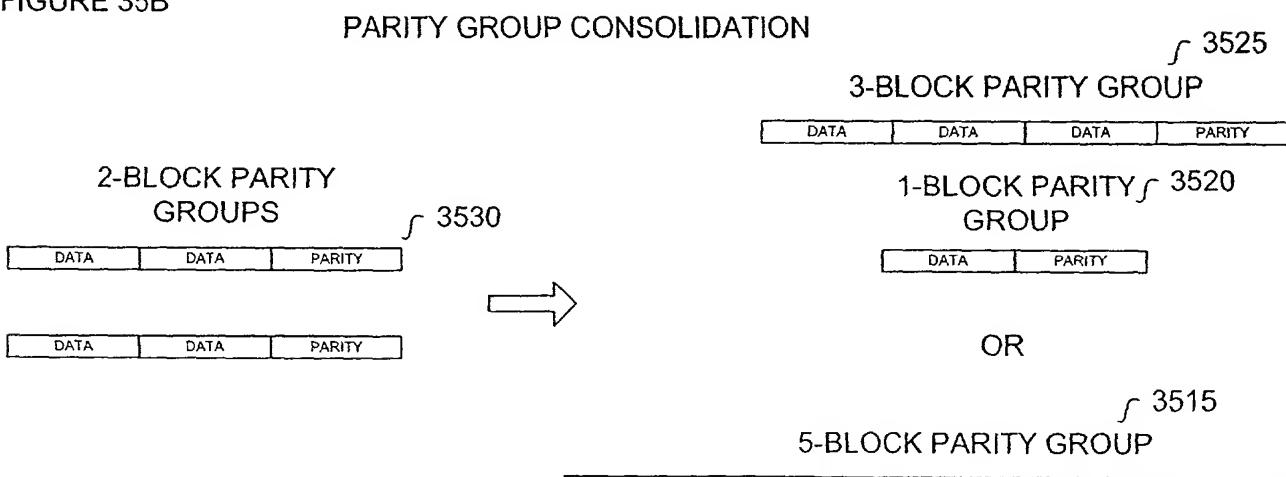


OR



FIGURE 35B

PARITY GROUP CONSOLIDATION



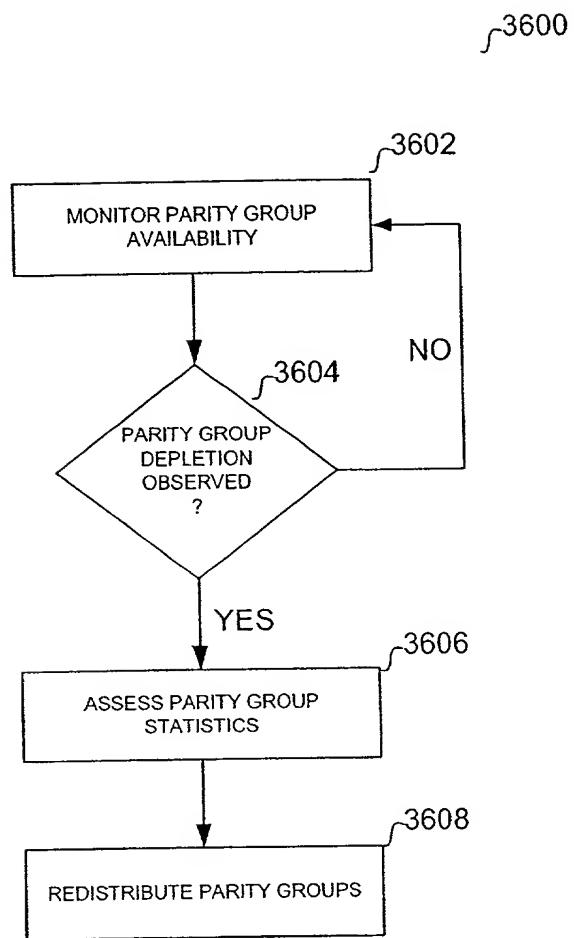


FIGURE 36

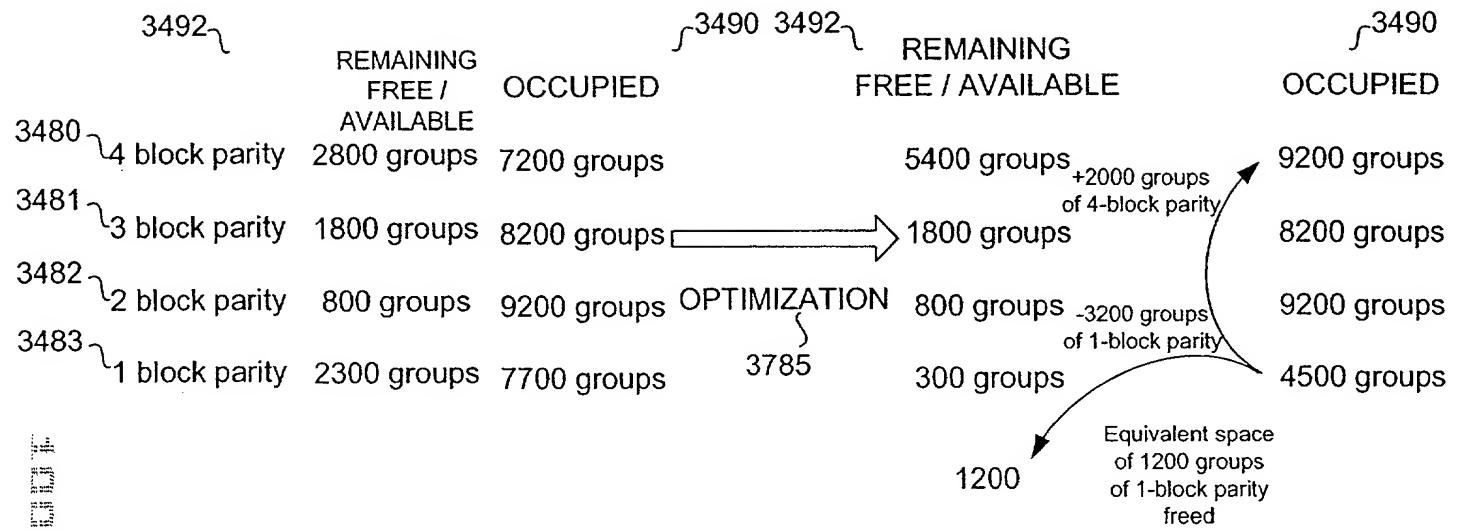


FIGURE 37

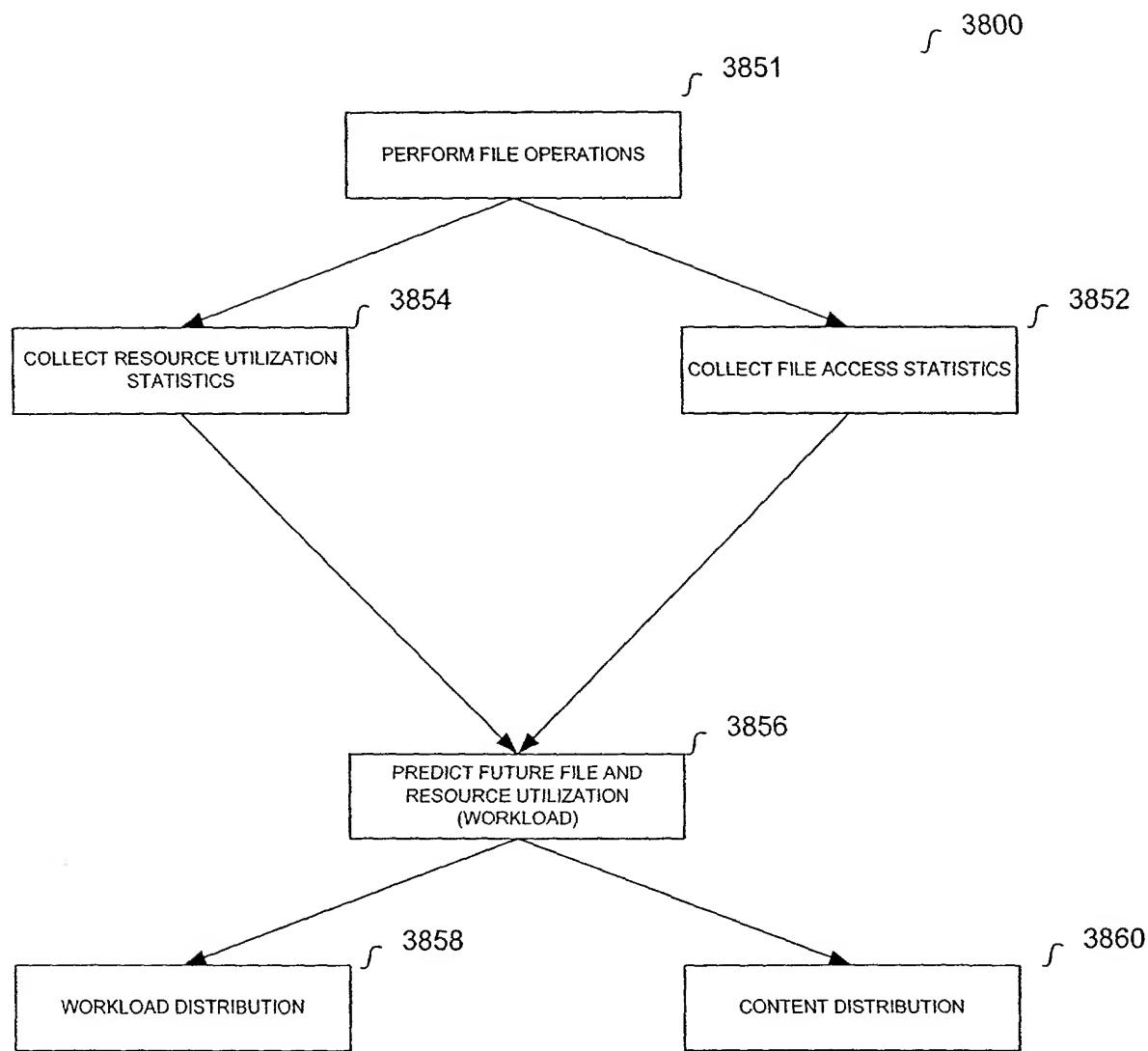
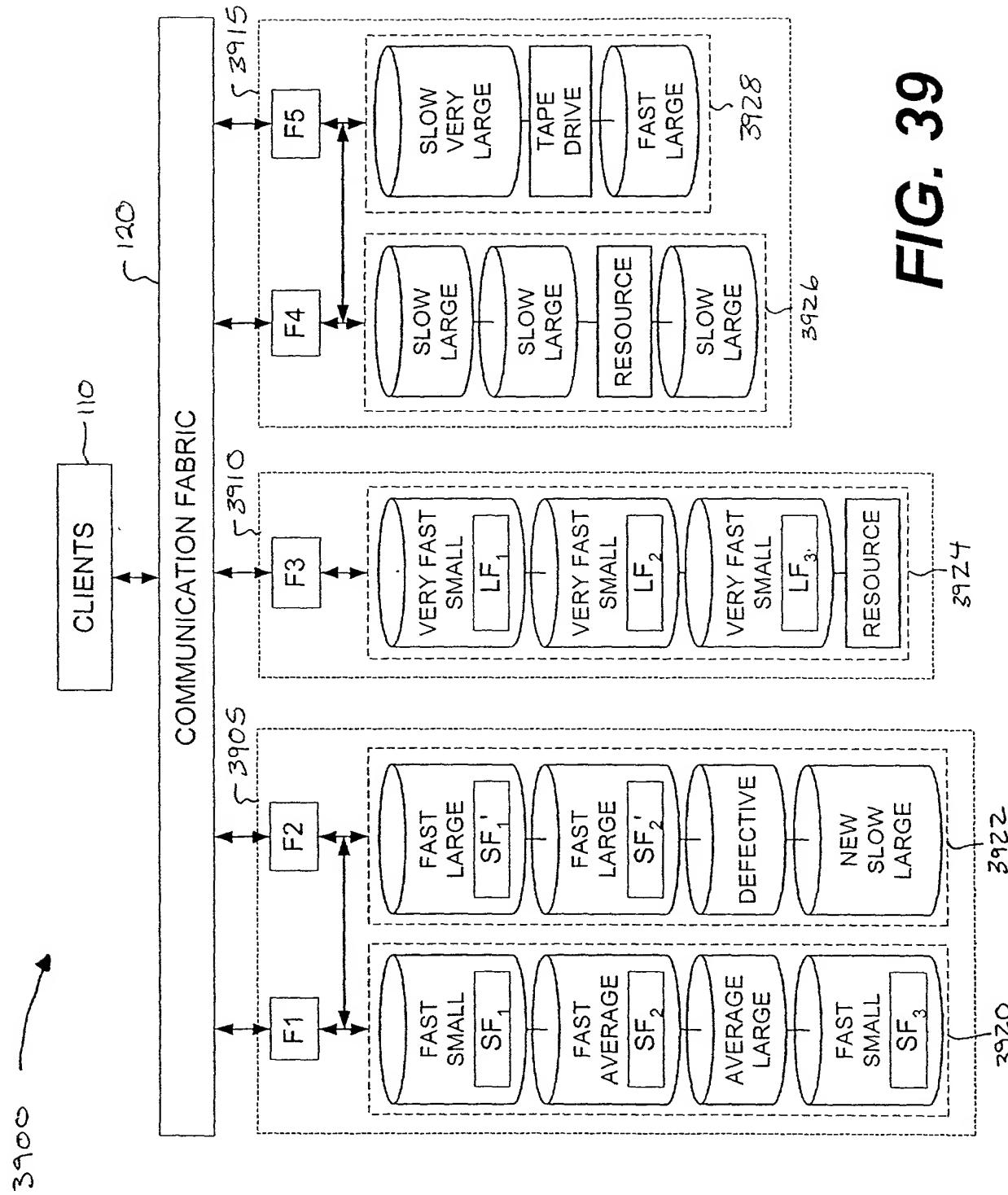
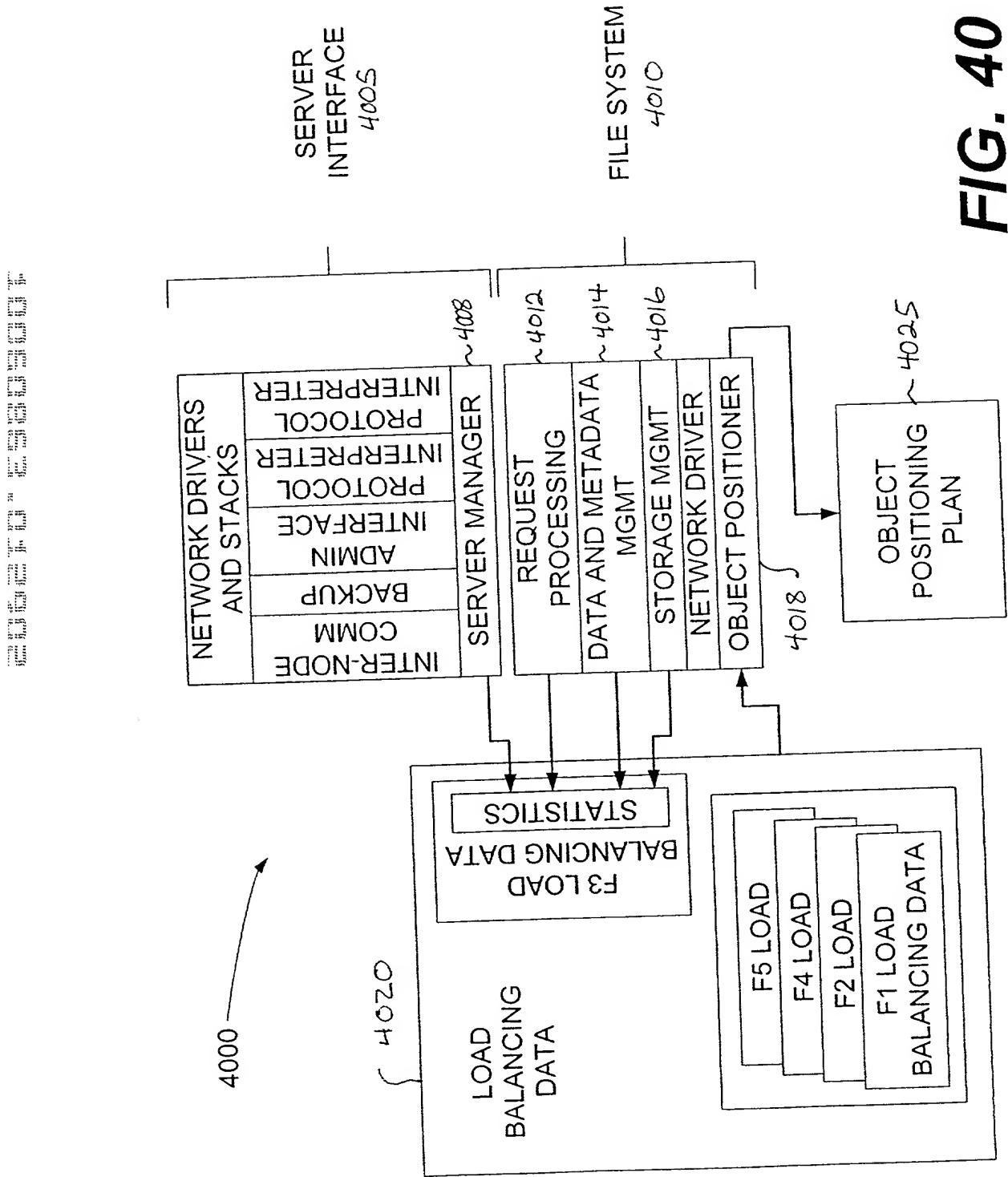


FIGURE 38

**FIG. 39**



**FIG. 40**



## F3 OBJECT POSITIONING PLAN

- Push LF to F4-F5 Cluster
- Issue File Handle For LF = Stale
- If Requested,
  - Send acceptance for copy
  - of SF to F1
  - Create copy of SF
  - Send file handle of SF to F1

4025

**FIG. 41**

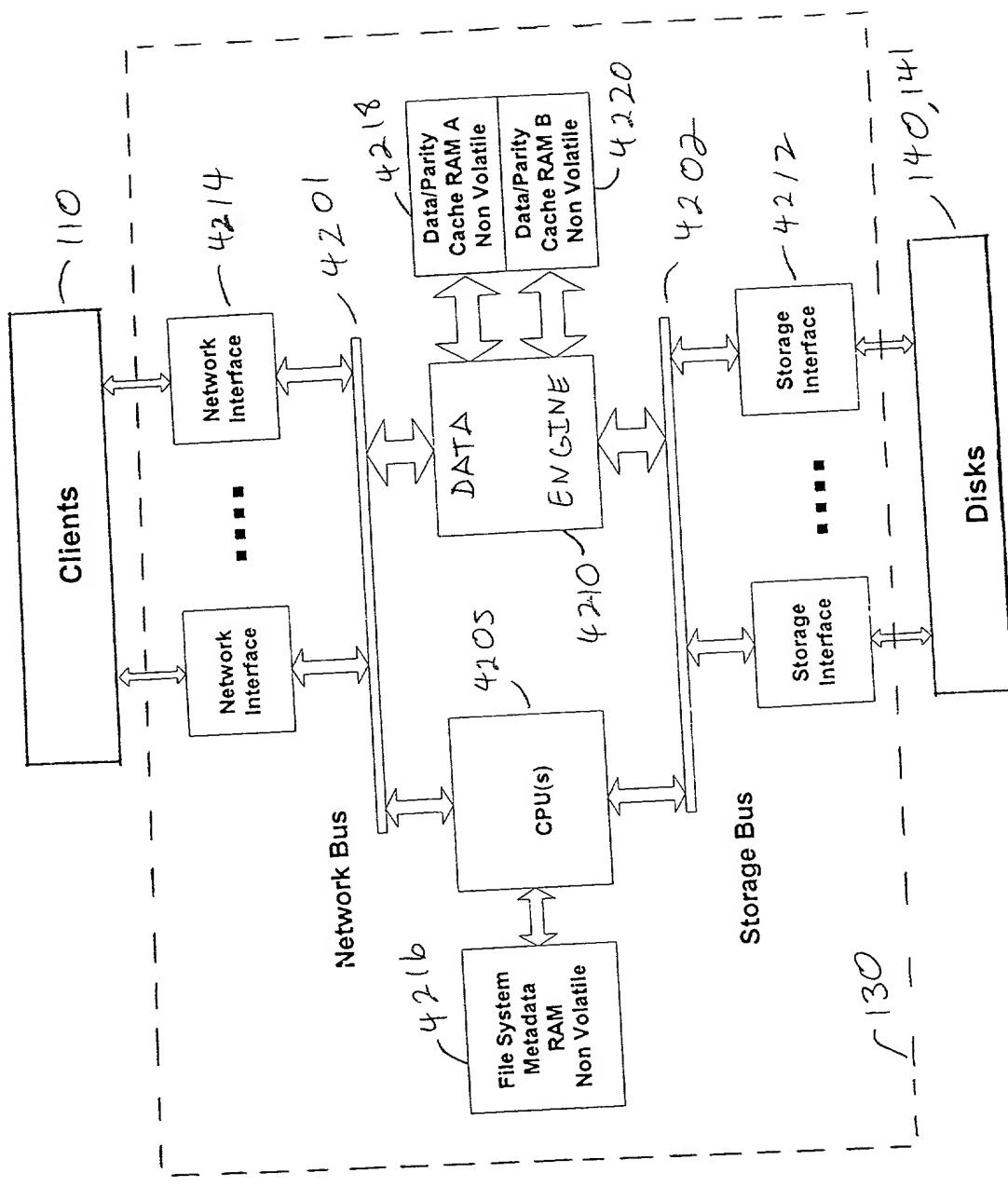


FIGURE 42

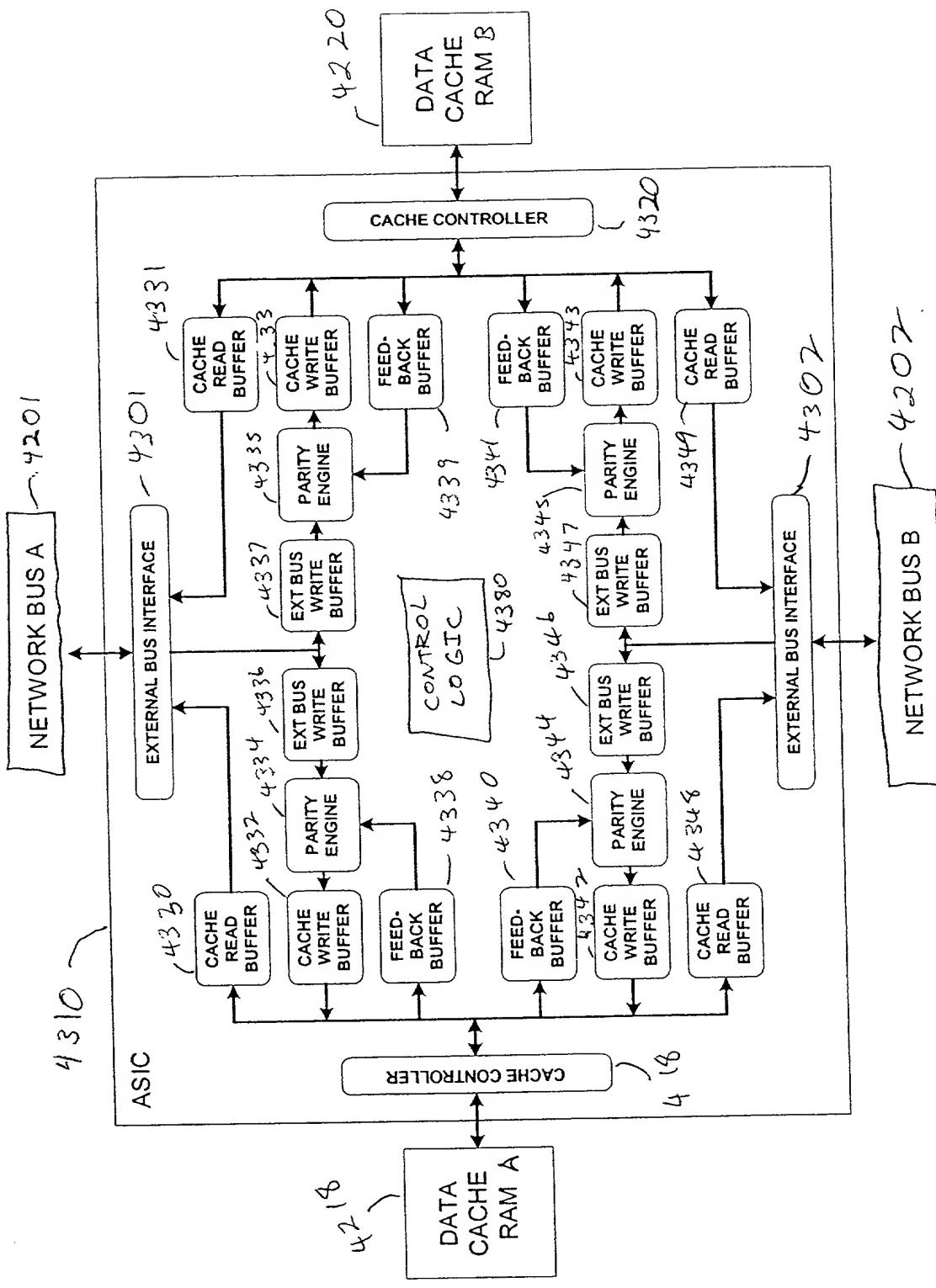


FIGURE 43

PCI map	Block Size	Opcode	Spare	Parity Index	Spare	RAM Adr
63-----62, 61-----59, 58-----56, 55-----51, 50-----35, 34, 32, 31-----0						


 FIGURE 44  
 4400